

CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT

INVITATION FOR BID NO.: B20/21-08

**AGRICULTURE, HORTICULTURE FACILITY PROJECT
AT
LAS POSITAS COLLEGE**

Bids Due:

Thursday, March 18, 2021 at 2:00 P.M.



Return Bids To:

**District Office
Purchasing & Warehouse Services Department
Attn: Marie Hampton
7600 Dublin Blvd., 3rd Floor
Dublin, CA 94568**

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NOTICE TO CONTRACTORS CALLING FOR BIDS

DISTRICT	CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT
PROJECT DESCRIPTION	BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project
LATEST TIME/DATE FOR RFI'S SUBMITTALS	Thursday, March 4, 2021 at 2:00 P.M.
LATEST TIME/DATE FOR SUBMISSION OF BIDS PROPOSALS	Thursday, March 18, 2021 at 2:00 P.M.
LOCATION FOR SUBMISSION OF BID PROPOSALS	Chabot-Las Positas Community College District 7600 Dublin Blvd., Dublin, CA 94568 Attn: Marie Hampton, Purchasing and Warehouse Manager
LOCATION FOR OBTAINING BID AND CONTRACT DOCUMENTS	District Website at: http://www.clpccd.org/business/open.php

NOTICE IS HEREBY GIVEN that the above-named California Community College District, acting by and through its Board of Trustees, hereinafter "the District" will receive up to, but not later than the above-stated date and time, sealed Bid Proposals for the Contract for the Work of the Project generally described as: **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project**

1. Submittal of Bid Proposals. All Bid Proposals shall be submitted on forms furnished by the District. Bid Proposals must conform with, and be responsive to, the Bid and Contract Documents, copies of which may be obtained from the District's website as set forth above. Only Bid Proposals submitted to the District at or prior to the date and time set forth above for the public opening and reading of Bid Proposals shall be considered.

2. Bid and Contract Documents. The Bid and Contract Documents are available at the District's website at: <http://www.clpccd.org/business/open.php> under Bid No. B20/21-08, Agriculture Science, Horticulture Facility Project.

3. Documents Accompanying Bid Proposal. Each Bid Proposal shall be accompanied by: (a) the required Bid Security; (b) Subcontractors List; (c) Non-Collusion Affidavit; (d) Certification of Pre-Bid Site Visit; (e) Statement of Bidder's Qualifications; and (f) Public Works Contractor Registration Certification Form. All information or responses of a Bidder in its Bid Proposal and other documents accompanying the Bid Proposal shall be complete, accurate and true; incomplete, inaccurate or untrue responses or information provided therein by a Bidder shall be grounds for the District to reject such Bidder's Bid Proposal for non-responsiveness.

4. Prevailing Wage Rates. Pursuant to California Labor Code §1773, the Director of the Department of Industrial Relations of the State of California has determined the generally prevailing rates of wages in the locality in which the Work is to be performed. Copies of these determinations, entitled "PREVAILING WAGE SCALE" are filed at the District's Administrative Offices located at 7600 Dublin Blvd., 3rd Floor, Dublin, CA 94568, and are available to any interested party upon request. Alternatively, prevailing wage rate classifications and determinations may be viewed and obtained by accessing the Division of Labor Standards Enforcement databases at <http://www.dir.ca.gov/dirdatabases.html>. The

Contractor awarded the Contract for the Work shall post a copy of all applicable prevailing wage rates for the Work at conspicuous locations at the Site of the Work. The Contractor and all Subcontractors performing any portion of the Work shall pay not less than the applicable prevailing wage rate for the classification of labor provide by their respective workers in prosecution and execution of the Work.

5. Contractors License Classification. In accordance with the provisions of California Public Contract Code §3300, the District requires that Bidders possess the following classification(s) of California Contractors License A and/or B. Any Bidder not so duly and properly licensed shall be subject to all penalties imposed by law. No payment shall be made for work, labor, materials or services provided under the Contract for the Work unless and until the Registrar of Contractors verifies to the District that the Bidder awarded the Contract is properly and duly licensed to perform the Work.

6. Contract Time. The date(s) for completion of portions of the Work, if applicable, and for achieving Substantial Completion of the Work shall be achieved as set forth in the Special Conditions. Failure to complete designated portions of the Work within the time(s) established in the Special Conditions and/or failure to achieve Substantial Completion of the Work within the Contract Time established in the Special Conditions shall subject the Contractor to assessment of Liquidated Damages as set forth in the Special Conditions.

7. Labor Compliance Program (AB 1506). The District has established a Labor Compliance Program ("LCP") pursuant to Labor Code §1771.5. The Contractor awarded the Contract for the Work shall comply with the LCP and provisions of the Contract Documents relating to implementation, compliance with, and enforcement of the LCP. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

8. Bid Security. Each Bid Proposal shall be accompanied by Bid Security in an amount not less than ten percent (10%) of the maximum amount of the Bid Proposal, inclusive of any additive Alternate Bid Item(s). Failure of any Bid Proposal to be accompanied by Bid Security in the form and in the amount required shall render such Bid Proposal to be non-responsive and rejected by the District.

9. No Withdrawal of Bid Proposals. Bid Proposals shall not be withdrawn by any Bidder for a period of sixty (60) days after the opening of Bid Proposals. During this time, all Bidders shall guarantee prices quoted in their respective Bid Proposals.

10. Job-Walk. The District will conduct **two (2) Mandatory** Job Walks. Job walk number one will be held on **Wednesday, February 10, 2021** and job walk number two will be held on **Tuesday, February 23, 2021 beginning at 10:00 AM. Bidders must attend one of the two job walks but not required to attend both.** Bidders are to meet at **Las Positas College, 3000 Campus Hill Drive, Facilities Management Office Trailer, Conference Room 1, adjacent to Building 1300, Livermore, California 94551. Bidders must attend the Site Walk to be eligible to participate in the bid.** Campus maps are available at www.laspositascollege.edu/. The Job Walk is mandatory. If a Bid Proposal is submitted by a Bidder whose representative(s) did not attend the entirety of the Mandatory Job Walk, such bid will be rejected by the District as being non-responsive.

11. Substitute Security. In accordance with the provisions of California Public Contract Code §22300, substitution of eligible and equivalent securities for any monies withheld by the District to ensure the Contractor's performance under the Contract will be permitted at the request and expense of the Contractor and in conformity with California Public Contract Code §22300. The foregoing notwithstanding, the Bidder to whom the Contract is awarded shall submit its written request to the District to permit the substitution of securities for retention under California Public Contract Code §22300 prior to the submission of its first Application for Progress Payment. The failure of such Bidder to make such written request to the District prior to submission of its first Application for Progress Payment shall be deemed a waiver of the Bidder's rights under California Public Contract Code §22300.

12. Waiver of Irregularities. The District reserves the right to reject any or all Bid Proposals or to waive any irregularities or informalities in any Bid Proposal or in the bidding.

13. Award of Contract. The Contract for the Work, if awarded, will be by action of the District's Board of Trustees to the responsible and responsive Bidder submitting the lowest priced Bid Proposal. If Alternate Bid Items are included in the bidding, the lowest total priced Bid Proposal will be determined on the basis of the Base Bid Proposal (only) in accordance with the applicable provisions of the Instructions for Bidders.

**CHABOT-LAS POSITAS COMMUNITY COLLEGE
DISTRICT**

Publication Dates:

**January 29, 2021
February 5, 2021**

ADVERTISEMENT**NOTICE TO BIDDERS**

Notice is hereby given that the Chabot-Las Positas Community College District, State of California, hereby calls for sealed bids – **Bid No. B20-21-08 Agriculture Science Horticulture Facility Project** to be delivered to the Bond Buyer, 7600 Dublin Blvd., Dublin, CA 94568 until **Thursday, March 18, 2021 at 2:00 p.m.**

To arrange for bid delivery before call Michael McClung, Bond Buyer, at 925-485-5205 to schedule a time during business hours to meet at the CLPCCD District Office. On March 18, 2021 the Bond Buyer will be on site from 8:00AM until 2:00PM to receive bids, but you will need to call 925-485-5205 on arrival to deliver the bid. Please plan for time accordingly.

At close of bid acceptance, said bids will be opened via Zoom Conference:

Topic: B20/21-08 Agriculture Science Horticulture Facility Project Bid Opening
Time: Mar 18, 2021 02:30 PM Pacific Time (US and Canada)

Join from PC, Mac, Linux, iOS or Android: <https://cccconfer.zoom.us/j/97379428661>

Or iPhone one-tap (US Toll): +16699006833,97379428661# or +13462487799,97379428661#

Or Telephone:

Dial:

+1 669 900 6833 (US Toll)

+1 346 248 7799 (US Toll)

+1 253 215 8782 (US Toll)

+1 312 626 6799 (US Toll)

+1 646 876 9923 (US Toll)

+1 301 715 8592 (US Toll)

Meeting ID: 973 7942 8661

International numbers available: <https://cccconfer.zoom.us/j/97379428661>

Or Skype for Business (Lync):

SIP:97379428661@lync.zoom.us

Faxed or emailed bids will not be accepted.

There will be **TWO (2)** Mandatory, Pre-Bid Conference and Job Walks: **First:** Wednesday, February 10, 2021 at 10:00 a.m. and **Second:** Tuesday, February 23, 2021 at 10:00 a.m. BOTH at **Las Positas College, 3000 Campus Hill Drive, Facilities Management Office Trailer, adjacent to Building 1300, Livermore, California 94551. Bidders must attend One (1) of the Campus Site Walks to be eligible to participate in the bid.** The Campus map is available at www.laspositascollege.edu/.

No contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.

Bids shall be presented in accordance with the specifications for the same, which are on file with the Purchasing and Warehouse Manager at the office address listed above. Bid documents will be available **by Friday, February 5, 2021** at the District's website:

<http://www.clpccd.org/business/open.php>

Inquiries regarding this bid should be directed to office of the Purchasing and Warehouse Manager, Marie Hampton at mhampton@clpccd.org and in the subject line reference **B20-21-08 Agriculture Science Horticulture Facility Project** on all email inquiries.

The Board of Trustees reserves the right to reject any and all bids and any and all items of such bids. A Project Labor Agreement has been negotiated and executed by and between the Chabot-Las Positas Community College District and the Alameda County Building and Construction Trades Council and Local Unions and is applicable to this **Bid No. 20/21-08**. This bid shall also be subject to any and all applicable laws, regulations and standards. For more information, please refer to the Facilities Measure A Program Website at [CLPCCDBTCACProjectLaborAgreement201118.pdf](http://www.clpccdbtcac.org/ProjectLaborAgreement201118.pdf) This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

For more information, please refer to the For more information, please refer to the Purchasing Website at <http://www.clpccd.org/business/open.php>

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INSTRUCTIONS FOR BIDDERS

1. **Preparation and Submittal of Bid Proposal.**
 - 1.1 **Bid Proposal Preparation.** All information required by the bid forms must be completely and accurately provided. Numbers shall be stated in both words and figures where so indicated in the bid forms; conflicts between a number stated in words and in figures are governed by the words. Partially completed Bid Proposals or Bid Proposals submitted on other than the bid forms included herein are non-responsive and will be rejected. Bid Proposals not conforming to these Instructions for Bidders and the Notice to Contractors Calling for Bids ("Call for Bids") may be deemed non-responsive and rejected.
 - 1.2 **Bid Proposal Submittal.** Bid Proposals shall be submitted at the place designated in the Call for Bids in sealed envelopes bearing on the outside the Bidder's name and address along with an identification of the Work for which the Bid Proposal is submitted. Bidders are solely responsible for timely submission of Bid Proposals to the District at the place designated in the Call for Bids.
 - 1.3 **Bidders Statement of Qualifications.** In order to be qualify to bid and be awarded a contract for the Project, the successful entity must review and answer prequalification questions under section 4 of the Statement of Qualifications.
 - 1.4 **Date and Time of Bid Proposal Submittal.** The District will place a clock ("the District Clock") in a conspicuous location at the place designated for submittal of Bid Proposals. For purposes of determining the time that a Bid Proposal is submitted, the District Clock shall be controlling. The foregoing notwithstanding, whether or not Bid Proposals are opened exactly at the time fixed in the Call for Bids, no Bid Proposals shall be received or considered by the District after it has commenced the public opening and reading of Bid Proposals; Bid Proposals submitted after such time are non-responsive and will be returned to the Bidder unopened.
2. **Bid Security.** Each Bid Proposal shall be accompanied by Bid Security in the form of: (a) cash, (b) a certified or cashier's check made payable to the District or (c) a Bid Bond, in the form and content attached hereto, in favor of the District executed by the Bidder as a principal and a Surety as surety (the "Bid Security") in an amount not less than the percentage of the maximum amount of the Bid Proposal. Any Bid Proposal submitted without the required Bid Security is non-responsive and will be rejected. If the Bid Security is in the form of a Bid Bond, the Bidder's Bid Proposal shall be deemed responsive only if the Bid Bond is in the form and content included herein and the Surety is an Admitted Surety Insurer under Code of Civil Procedure §995.120.
3. **Documents Accompanying Bid Proposal; Signatures.** The Bid Proposal must be submitted with: Bid Security, Subcontractors List, Statement of Qualifications, Certification of Pre-Bid Site Visit, Public Works Contractor Registration Certification Form and Non-Collusion Affidavit. The Bid Proposal, Statement of Qualifications and the Non-Collusion Affidavit shall be executed by an individual duly authorized to execute the same on behalf of the Bidder.
4. **Modifications.** Changes to the bid forms which are not specifically called for or permitted may result in the District's rejection of the Bid Proposal as being non-responsive. No oral or telephonic modification of any submitted Bid Proposal will be considered. A written modification may be considered only if actually received by the District prior to the scheduled closing time for receipt of Bid Proposals and the public opening thereof.
5. **Erasures; Inconsistent or Illegible Bid Proposals.** Bid Proposals must not contain any erasures, interlineations or other corrections unless the same are suitably authenticated by affixing in the

margin immediately opposite such erasure, interlineations or correction the surname(s) of the person(s) signing the Bid Proposal. Any Bid Proposal not conforming to the foregoing may be deemed by the District to be non-responsive. If any Bid Proposal or portions thereof, is determined by the District to be illegible, ambiguous or inconsistent, whether by virtue of any erasures, interlineations, corrections or otherwise, the District may reject such a Bid Proposal as being non-responsive.

- 6. Examination of Site and Contract Documents.** Each Bidder shall, at its sole cost and expense, inspect the Site and to become fully acquainted with the Contract Documents and conditions affecting the Work. The failure of a Bidder to receive or examine any of the Contract Documents or to inspect the Site shall not relieve such Bidder from any obligation with respect to the Bid Proposal, or the Work required under the Contract Documents. The District assumes no responsibility or liability to any Bidder for, nor shall the District be bound by, any understandings, representations or agreements of the District's agents, employees or officers concerning the Contract Documents or the Work made prior to execution of the Contract which are not in the form of Bid Addenda duly issued by the District. The submission of a Bid Proposal shall be deemed prima facie evidence of the Bidder's full compliance with the requirements of this section.
- 7. Withdrawal of Bid Proposal.** Any Bidder may withdraw its Bid Proposal by of written request actually received by the District prior to the scheduled closing time for the receipt of Bid Proposals and the District's public opening and reading of Bid Proposals. A written notice of withdrawal of a submitted Bid Proposal received after the scheduled closing time for receipt of Bid Proposals or the District's public opening and reading of Bid Proposals shall not be considered by the District, nor effective to withdraw such Bid Proposal.
- 8. Agreement and Bonds.** The Agreement which the successful Bidder, as Contractor, will be required to execute along with the forms and amounts of the Labor and Material Payment Bond, Performance Bond and other documents and instruments which will be required to be furnished are included in the Contract Documents and shall be carefully examined by the Bidder.
- 9. Interpretation of Drawings, Specifications or Contract Documents.** Any Bidder in doubt as to the true meaning of any part of the Contract Documents; finds discrepancies, errors or omissions therein; or finds variances in any of the Contract Documents with applicable rules, regulations, ordinances and/or laws, a written request for an interpretation or correction thereof may be submitted to the District. It is the sole and exclusive responsibility of the Bidder to submit such request not less than three (3) days prior to the scheduled closing date for the receipt of Bid Proposals. Interpretations or corrections of the Contract Documents will be by written addendum issued by the District or the Architect. A copy of any such addendum will be mailed, faxed, emailed or delivered to each Bidder receiving a set of the Contract Documents. No person is authorized to render an oral interpretation or correction of any portion of the Contract Documents to any Bidder, and no Bidder is authorized to rely on any such oral interpretation or correction. Failure to request interpretation or clarification of any portion of the Contract Documents pursuant to the foregoing is a waiver of any discrepancy, defect or conflict therein.
- 10. District's Right to Modify Contract Documents.** Before the public opening and reading of Bid Proposals, the District may modify the Work, the Contract Documents, or any portion(s) thereof by the issuance of written addenda disseminated to all Bidders who have obtained a copy of the Specifications, Drawings and Contract Documents pursuant to the Call for Bids. If the District issues any addenda during the bidding, the failure of any Bidder to acknowledge such addenda in its Bid Proposal will render the Bid Proposal non-responsive and rejected.
- 11. Non-Collusion Affidavit.** No person, firm, corporation or other entity shall submit or be interested in more than one Bid Proposal for the same Work; provided, however, that a person, firm or corporation that has submitted a sub-proposal to a Bidder or who has quoted prices for materials

to a Bidder is not thereby disqualified from submitting a sub-proposal, quoting prices to other Bidders or submitting a Bid Proposal for the proposed Work to the District. The form of Non-Collusion Affidavit included in the Contract Documents must be completed and duly executed on behalf of the Bidder; failure of a Bidder to submit a completed and executed Non-Collusion Affidavit with its Bid Proposal will render the Bid Proposal non-responsive.

12. Award of Contract.

12.1 Waiver of Irregularities or Informalities. The District reserves the right to reject any and all Bid Proposals or to waive any irregularities or informalities in any Bid Proposal or in the bidding.

12.2 Award to Lowest Responsive and Responsible Bidder. The award of the Contract, if made by the District through action of its Board of Trustees, will be to the responsible Bidder submitting the lowest priced responsive Bid Proposal on the basis of the Base Bid Proposal, in accordance with these Instructions for Bidders. The low bidder will be determined by the sum of Bid Items 1 and 2.

12.3 Selection of Alternate Bid Items. Not Used.

12.4 Alternate Bid Items Not Included in Award of Contract. Bidders are referred to the provisions of the Contract Documents permitting the District, during performance of the Work, to add or delete from the scope of the Work any or all of the Alternate Bid Items with the cost or credit of the same being the amount(s) set forth by in the Alternate Bid Items Proposal.

12.5 Responsive Bid Proposal. A responsive Bid Proposal shall mean a Bid Proposal which conforms, in all material respects, to the Bid and Contract Documents.

12.6 Responsible Bidder. A responsible Bidder is a Bidder who has the capability in all respects, to perform fully the requirements of the Contract Documents and the moral and business integrity and reliability, which will assure good faith performance. In determining responsibility, the following criteria will be considered: (i) the ability, capacity and skill of the Bidder to perform the Work of the Contract Documents; (ii) whether the Bidder can perform the Work promptly and within the time specified, without delay or interference; (iii) the character, integrity, reputation, judgement, experience and efficiency of the Bidder; (iv) the quality of performance of the Bidder on previous contracts, by way of example only, the following information will be considered: (a) the administrative, consultant or other cost overruns incurred by the District on previous contracts with the Bidder; (b) the Bidder's compliance record with contract general conditions on other projects; (c) the submittal by the Bidder of excessive and/or unsubstantiated extra cost proposals and claims on other projects; (d) the Bidder's record for completion of work within the contract time and the Bidder's compliance with the scheduling and coordination requirements on other projects; (e) the Bidder's demonstrated cooperation with the District and other contractors on previous contracts; (f) whether the work performed and materials furnished on previous contracts was in accordance with the Contract Documents; (v) the previous and existing compliance by the Bidder with laws and ordinances relating to contracts; (vi) the sufficiency of the financial resources and ability of the Bidder to perform the work of the Contract Documents; (vii) the quality, availability and adaptability of the goods or services to the particular use required; (viii) the ability of the Bidder to provide future maintenance and service for the warranty period of the Contract; (ix) whether the Bidder is in arrears on debt or contract or is a defaulter on any surety bond; (x) such other information as may be secured by the District having a bearing on the decision to award the Contract, to include without limitation the ability, experience and commitment of the Bidder to properly and

reasonably plan, schedule, coordinate and execute the Work of the Contract Documents and whether the Bidder has ever been debarred from bidding or found ineligible for bidding on any other projects. The ability of a Bidder to provide the required bonds will not of itself demonstrate responsibility of the Bidder.

13. Subcontractors.

13.1 Designation of Subcontractors; Subcontractors List. Each Bidder shall submit a list of its proposed Subcontractors for the proposed Work as required by the Subletting and Subcontracting Fair Practices Act (California Public Contract Code §§4100 et seq.) on the form furnished. The failure of any Bid Proposal to include all information required by the Subcontractors List will result in rejection of the Bid Proposal for non-responsiveness. Each Subcontractor shall maintain annual compliance with Senate Bill 854 and Workers Compensation/Employers Liability Insurance and Commercial General Liability Insurance as required by the Contract.

13.2 Work of Subcontractors. All Bidders are referred to the Contract Documents and the notation therein that all Contract Documents are intended to be complimentary and that the organization or arrangements of the Specifications and Drawings shall not limit the extent of the Work of the Contract Documents. Accordingly, all Bidders are encouraged to disseminate all of the Specifications, Drawings and other Contract Documents to all persons or entities submitting sub-bids to the Bidder. The omission of any portion or item of Work from the Bid Proposal or from the sub-bidders' sub-bids which is/are necessary to produce the intended results and/or which are reasonably inferable from the Contract Documents is not a basis for adjustment of the Contract Price or the Contract Time. Dissemination of the Contract Documents to sub-bidders and dissemination of addenda issued during the bidding process is solely the responsibility of each Bidder.

13.3 Subcontractor Bonds. In accordance with California Public Contract Code §4108, if a Bidder requires a bond or bonds of its Subcontractor(s), whether the expense of procuring such bond or bonds are to be borne by the Bidder or the Subcontractor(s), such requirements shall be specified in the Bidder's written or published request for sub-bids. Failure of the Bidder to comply with these requirements shall preclude the Bidder from imposing bonding requirements upon its Subcontractor(s) or rejection of a Subcontractor's bid under California Public Contract Code §4108(b).

14. Workers' Compensation Insurance. Pursuant to California Labor Code §3700, the successful Bidder shall secure Workers' Compensation Insurance for its employees engaged in the Work of the Contract. The successful bidder shall sign and deliver to the District the following certificate prior to performing any of the Work under the Contract:

"I am aware of the provisions of §3700 of the California Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that Code and I will comply with such provisions before commencing the performance of the Work of the Contract."

The form of such Certificate is included as part of the Contract Documents.

15. Bid Security Return. The Bid Security of the three or more low Bidders, the number being solely at the discretion of the District, will be held by the District for ten (10) days after the period for which Bid Proposals must be held open (which is set forth in the Call for Bids) or until posting by the successful Bidder(s) of the bonds, certificates of insurance required and return of executed copies of the Agreement, whichever first occurs, at which time the Bid Security of such other Bidders will be returned to them.

16. **Forfeiture of Bid Security.** If the Bidder awarded the Contract fails or refuses to execute the Agreement within ten (10) calendar days from the date of receiving notification that it is the Bidder to whom the Contract has been awarded, the District may declare the Bidder's Bid Security forfeited as damages caused by the failure of the Bidder to enter into the Contract and may thereupon award the Contract for the Work to the responsible Bidder submitting the next lowest Bid Proposal or may call for new bids, in its sole and exclusive discretion.
17. **Contractor's License.** No Bid Proposal will be considered from a Bidder who, at the time Bid Proposals are opened, is not licensed to perform the Work, in accordance with the Contractors License Law, California Business & Professions Code §§7000 et seq. This requirement is not a mere formality and will not be waived by the District or its Board of Trustees. The required California Contractor's License classification(s) for the Work is/are set forth in the Call for Bids.
18. **Anti-Discrimination.** It is the policy of the District that there is no discrimination against any prospective or active employee engaged in the Work because of race, color, ancestry, national origin, religious creed, sex, age or marital status. All Bidders agree to comply with the District's anti-discrimination policy and all applicable Federal and California anti-discrimination laws including but not limited to the California Fair Employment & Housing Act beginning with California Government Code §§12940 et seq. and California Labor Code §1735. In addition, all Bidders agree to require like compliance by any Subcontractor employed by them on the Work of the Contract.
19. **Bidder's Qualifications.** Each Bidder shall submit with its Bid Proposal the Statement of Bidder's Qualifications, which is included within the Contract Documents. All information required by Statement of Bidder's Qualifications shall be completely and fully provided. Any Bid Proposal not accompanied by the Statement of Bidder's Qualifications completed with all information required and bearing the signature of the Bidder's duly authorized representative under penalty of perjury will render the Bid Proposal non-responsive and rejected. If the District determines that any information provided by a Bidder in the Statement of Bidder's Qualifications is false or misleading, or is incomplete so as to be false or misleading, the District may reject the Bid Proposal submitted by such Bidder as being non-responsive.
20. **Job-Walk.** The District will conduct two (2) Job-Walks at the time(s) and place(s) designated in the Call for Bids. The District may in its sole and exclusive discretion, elect to conduct one or more Job-Walk(s) in addition to that set forth in the Call for Bids, in which event the District shall notify all Bidders who have theretofore obtained the Contract Documents pursuant to the Call for Bids of any such additional Job-Walk. If the District elects to conduct any Job-Walk in addition to that set forth in the Call for Bids, the District shall in its notice of any such additional Job-Walk(s), indicate whether Bidders' attendance at such additional Job-Walk(s) is/are mandatory. If attendance at the Job Walk is indicated in the Call for Bids as being mandatory, the failure of any Bidder to have its authorized representative present at the entirety of the Job-Walk will render the Bid Proposal of such Bidder to be non-responsive. Where the Job-Walks are mandatory, a Bidder may have more than one authorized representative and/or representatives of its Subcontractors present at the Job-Walk; provided, however that attendance by representatives of the Bidder's Subcontractors without attendance by a representative of the Bidder shall not be sufficient to meet the Bidder's obligations hereunder and will render the Bid Proposal of such Bidder to be non-responsive. The District will reject the Bid Proposal of a Bidder who obtains the Bid and Contract Documents after the date of the Mandatory Job-Walks set forth in the Call for Bids unless a Job-Walk is requested by such Bidder and a Job-Walk is conducted by the District in accordance with the following provisions. The District may, in its sole and exclusive discretion, conduct such requested Job-Walk taking into consideration factors such as the time remaining prior to the scheduled opening of Bid Proposals. Any such requested Job Walk will be conducted only upon the requesting Bidder's agreement to reimburse the District for the actual and/or reasonable costs for the District's staff and its agents and representatives in arranging for and conducting such additional Job-Walk.

- 21. Public Records.** Bid Proposals and other documents responding to the Call for Bids become the exclusive property of the District upon submittal to the District. At such time as the District issues the Notice of Intent to award the Contract pursuant to these Instructions for Bidders, all Bid Proposals and other documents submitted in response to the Call for Bids become a matter of public record and shall be thereupon be considered public records, except for information contained in such Bid Proposals deemed to be Trade Secrets (as defined in California Civil Code §3426.1) and information provided in response to the Statement of Qualifications. A Bidder that indiscriminately marks all or most of its Bid Proposal as exempt from disclosure as a public record, whether by the notations of "Trade Secret," "Confidential," "Proprietary," or otherwise, may result render the Bid Proposal non-responsive and rejected. The District is not liable or responsible for the disclosure of such records, including those exempt from disclosure if disclosure is deemed required by law, by an order of Court, or which occurs through inadvertence, mistake or negligence on the part of the District or its officers, employees or agents. At such time as Bid Proposals are deemed a matter of public record, pursuant to the above, any Bidder or other party shall be afforded access for inspection and/or copying of such Bid Proposals, by request made to the District in conformity with the California Access to Public Records Act, California Government Code §§6250, et. seq. If the District is required to defend or otherwise respond to any action or proceeding wherein request is made for the disclosure of the contents of any portion of a Bid Proposal deemed exempt from disclosure hereunder, the Bidder submitting the materials sought by such action or proceeding agrees to defend, indemnify and hold harmless the District in any action or proceeding from and against any liability, including without limitation attorneys' fees arising therefrom. The party submitting materials sought by any other party shall be solely responsible for the cost and defense in any action or proceeding seeking to compel disclosure of such materials; the District's sole involvement in any such action shall be that of a stakeholder, retaining the requested materials until otherwise ordered by a court of competent jurisdiction.
- 22. Drug Free Workplace Certificate.** In accordance with California Government Code §§8350 et seq., the Drug Free Workplace Act of 1990, the successful Bidder will be required to execute a Drug Free Workplace Certificate concurrently with execution of the Agreement. The successful Bidder will be required to implement and take the affirmative measures outlined in the Drug Free Workplace Certificate and in California Government Code §§8350 et seq. Failure of the successful Bidder to comply with the measures outlined in the Drug Free Workplace Certificate and in California Government Code §§8350 et seq. may result in penalties, including without limitation, the termination of the Agreement, the suspension of any payment of the Contract Price otherwise due under the Contract Documents and/or debarment of the successful Bidder.
- 23. Public Works Contractor Registration Certificate.** Pursuant to California Senate Bill 854, the qualified Contractor shall be registered with the California's Department of Industrial Relations (DIR) and its subcontractors who intend to bid or perform work on any public works project, as defined under Labor Code Section 1720. The qualified Contractor shall sign and deliver to the District the form of Public Works Contractor Registration Certification included with the Contract Documents.
- 24. Compliance with Immigration Reform and Control Act of 1986.** The Bidder is solely and exclusively responsible for employment of individuals for the Work of the Contract in conformity with the Immigration Reform and Control Act of 1986, 8 USC §§1101 et seq. (the "IRCA"); the successful Bidder shall also require that any person or entity employing labor in connection with any of the Work of the Contract shall so similarly comply with the IRCA.
- 25. Notice of Intent to Award Contract.** Following the public opening and reading of Bid Proposals, the District will issue a Notice of Intent to Award the Contract, identifying the Bidder to whom the District intends to award the Contract and the date/time/place of the District's Board of Trustees meeting at which award of the Contract will be considered.

- 26. Bid Protest.** Any Bidder submitting a Bid Proposal to the District may file a protest of the District's intent to award the Contract provided that each and all of the following are complied with:
- (i) The bid protest is in writing;
 - (ii) The bid protest is filed and received by the District's Vice-Chancellor, Facilities Planning and Management not more than five (5) calendar days following the date of issuance of the District's Notice of Intent to Award the Contract; and
 - (iii) The written bid protest sets forth, in detail, all grounds for the bid protest, including without limitation all facts, supporting documentation, legal authorities and argument in support of the grounds for the bid protest; any matters not set forth in the written bid protest shall be deemed waived. All factual contentions must be supported by competent, admissible and creditable evidence.

Any bid protest not conforming to the foregoing shall be rejected by the District as invalid. Provided that a bid protest is filed in strict conformity with the foregoing, the District's Vice-Chancellor, Facilities Planning and Management or such individual(s) as may be designated by him/her, shall review and evaluate the basis of the bid protest. Either, the District's Vice-Chancellor, Facilities Planning and Management or other individual designated by him/her shall provide the bidder submitting the bid protest with a written statement concurring with or denying the bid protest. The District's Board of Trustees will render a final determination and disposition of a bid protest by taking action to adopt, modify or reject the disposition of a bid protest as reflected in the written statement of the District's Vice-Chancellor, Facilities Planning and Management or his/her designee. Action by the District's Board of Trustees relative to a bid protest shall be final and not subject to appeal or reconsideration by the District's Vice-Chancellor, Facilities Planning and Management any other employee or officer of the District or the District's Board of Trustees. The rendition of a written statement by the District's Vice-Chancellor, Facilities Planning and Management (or his/her designee) and action by the District's Board of Trustees to adopt, modify or reject the disposition of the bid protest reflected in such written statement shall be express conditions precedent to the institution of any legal or equitable proceedings relative to the bidding process, the District's intent to award the Contract, the District's disposition of any bid protest or the District's decision to reject all Bid Proposals. In the event that any such legal or equitable proceedings are instituted and the District is named as a party thereto, the prevailing party(ies) shall recover from the other party(ies), as costs, all attorneys' fees and costs incurred in connection with any such proceeding, including any appeal arising therefrom.

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NON-COLLUSION AFFIDAVIT

STATE OF CALIFORNIA)
COUNTY OF _____)

PROJECT: BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project

I, _____, being first duly sworn, deposes and says that I
(Typed or Printed Name)
am the _____ of _____, the party
(Title) (Bidder Name)
submitting the foregoing Bid Proposal ("the Bidder"). In connection with the foregoing Bid Proposal, the undersigned declares, states and certifies that:

1. The Bid Proposal is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization or corporation.
2. The Bid Proposal is genuine and not collusive or sham.
3. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any other bidder or anyone else to put in sham bid, or to refrain from bidding.
4. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price, or that of any other bidder, or to fix any overhead, profit or cost element of the bid price or that of any other bidder, or to secure any advantage against the public body awarding the contract or of anyone interested in the proposed contract.
5. All statements contained in the Bid Proposal and related documents are true.
6. The bidder has not, directly or indirectly, submitted the bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any person, corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Executed this ____ day of _____, 2021 at _____.
(City, County and State)

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Signature

(Address)

Name Printed or Typed

(City, County and State)

(_____) _____
(Area Code and Telephone Number)

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STATEMENT OF BIDDER'S QUALIFICATIONS

1. Bidder's Organization

- 1.1 Form of entity of Bidder, i.e., corporation, partnership, etc. _____
- 1.1.1 If a corporation, state the following:
State of incorporation: _____
Date of incorporation: _____
President/Chief Executive Officer: _____
Secretary: _____
Treasurer/Chief Financial Officer: _____
- 1.1.2 If a partnership, state the following:
Type of partnership, i.e., general partnership, limited partnership: _____

Names of all general partners, if any of the general partners are not natural persons, provide the information for each such general partner requested by Paragraphs 1.1.1, 1.1.2 and 1.1.4 as appropriate: _____

- 1.1.3 If a proprietorship, state the names of all proprietors: _____

- 1.1.4 If a joint venture, state the following
Date of organization: _____
Names of all joint venture members. For each member of the joint venture, provide the information requested by Paragraphs 1.1.1, 1.1.2 and 1.1.3 for each joint venture member, as applicable: _____

- 1.2 Number of years your organization has been in business as a contractor: _____
- 1.3 Number of years your organization has conducted business under its present name:

- 1.4 If your organization has conducted business under a name or name style different than your organization's present name, identify all prior name(s) or name style(s):

1.5 Your organization's Federal Tax Identification Number: _____

1.6 Your Public Works Contractor Registration Number: _____

2. Licensing

2.1 California Contractors License: Number: _____
Expiration Date: _____
Responsible Managing Employee/Officer: _____
License Classification(s): _____

2.2 Has a claim or other demand ever been made against your organization's California Contractors License Bond? _____ Yes _____ No
If yes, on a separate attachment, state the following: (i) the name, address and telephone number of each person or entity making claim or demand; (ii) the date of each claim or demand; (iii) the circumstances giving rise to each such claim or demand; and (iv) the disposition of each such claim or demand.

2.3 Has a complaint ever been filed against your organization's California Contractors License with the California Contractors State License Board? _____ Yes _____ No
If yes, on a separate attachment, state the following for each complaint: (i) the name, address and telephone number of each person or entity making the complaint; (ii) the date of each complaint; (iii) the circumstances giving rise to each such complaint; and (iv) the disposition of each such complaint, including without limitation, any disciplinary or other action imposed or taken by the California Contractors State License Board as a result of any such complaint.

2.4 Has your contractors' license(s) been consistently active for at least five (5) years without revocation or suspension? _____ Yes _____ No

3. Experience

3.1 Categories of work (other than management/supervision) your organization typically performs with your own forces _____

3.2 On a separate attachment, list similar sized construction project completed by your organization in the past seven (7) years and for each project identified, state: (i) a general description of the work performed by your organization on the project; (ii) the dollar value of the work performed or to be performed by your organization, percentage of change orders for the project, original completion date and final completion date (iii) the project owner's name, address, telephone number and email address, the name of the project owner's representative, address, telephone number and email address; and (iv) the project architect's name, address, telephone number, contact person and their email address.

3.3 On a separate attachment, list all construction projects your organization has in progress and for each project listed, state: (i) a general description of the work performed by your organization on the project; (ii) the dollar value of the work performed or to be performed

by your organization; (iii) the project owner's name, name of the project owner's representative and the address and telephone number of the project owner and the project owner's representative; (iv) the project architect's name, address, telephone number and contact person; (v) percent presently complete; and (vi) the current scheduled completion date.

4. Performance History

- 4.1 Claims and lawsuits (if you answer yes to any of the following, you must attach details).
 - 4.1.1 Have any lawsuits or other administrative, legal, arbitration or other proceedings, ever been brought or commenced against your organization or any of its principals, officers or equity owners in connection with any construction contract or construction project? Yes No
 - 4.1.2 Has your organization ever filed a lawsuit or commenced other administrative, legal or other proceedings in connection with any construction contract or construction project? Yes No
 - 4.1.3 Are there any judgements, orders, decrees, mediation or arbitration awards pending, outstanding against your organization or any of the officers, directors, employees or principals of your organization? Yes No
- 4.2 Has your organization ever refused to sign a construction contract awarded to it? Yes No
- 4.3 Has your organization ever failed to complete a construction contract? Yes No
- 4.4 Has your organization ever been declared in default of a construction contract within California within the past ten (10) years? Yes No
- 4.5 Has any construction contract to which your organization has been or is a party to been terminated for the convenience of the project owner? Yes No
- 4.6 Has a claim or other demand ever been asserted against any Bid Bond, Performance Bond, or Payment Bond posted by your organization in connection with any construction contract or your submittal of a bid proposal for a construction contract? Yes No
- 4.7 Has your Firm or an Associated Firm or any of their owners or officers who owns ten percent (10%) or more equity interest of your organization been convicted of a crime under federal, state, or local law involving: bidding for, awarding of, or performance of a contract with a public entity; making a false claim(s) to any public entity; or fraud, theft, or other act of dishonesty to any contracting party within the past ten (10) years? Yes No
- 4.8 Has your organization or any predecessor to your organization been charged with a violation of the California False Claims Act or similar federal statute within the past ten (10) years? Yes No

4.9 Has any individual or entity who owns ten percent (10%) or more of the equity interest of your organization been an equity owner of ten percent (10%) or more of the equity interest of any other entity or organization, within the past ten (10) years, which has been charged with a violation of the California False Claims Act or similar federal statute within the past ten (10) years?
 Yes No

4.10 Has any individual or entity who owns ten percent (10%) or more of the equity interest of your organization been charged with a violation of the California False Claims Act or similar federal statute within the past ten (10) years?
 Yes No

If "YES" to any of the above questions you will Not qualify for this project.

4.11 Has your Firm contracted for and completed construction of a minimum of three (3) California community college, university or higher education projects, each with a value of at least **\$5,000,000**, and all within the past seven (7) years?
 Yes No

5.0 **References** (Include name, contact person, telephone, email and address for each reference provided):

5.1 Trade References (three (3) minimum)

5.2 Bank References

5.3 Public Works Inspectors of Record (K-12 or community college project)

5.4 Owner references (three (3) minimum, California community college districts and/or K-12 school district)

6.0 Accuracy and Authority

The undersigned is duly authorized to execute this Statement of Bidders Qualifications under penalty of perjury on behalf of the Bidder. The undersigned warrants and represents that he/she has personal knowledge of each of the responses to this Statement of Bidder's Qualifications and/or that he/she has conducted all necessary and appropriate inquiries to determine the truth, completeness and accuracy of responses to this Statement of Bidder's Qualifications.

The undersigned declares and certifies that the responses to this Statement of Bidder's Qualifications are complete and accurate; there are no omissions of material fact or information that render any response to be false or misleading and there are no misstatements of fact in any of the responses.

Executed this ___ day of _____ 2021 at _____

(City and State)

I declare under penalty of perjury under California law that the foregoing is true and correct.

(Signature)

(Typed or written name)

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BID BOND

KNOW ALL MEN BY THESE PRESENTS that we, _____, as Surety and _____, as Principal, are jointly and severally, along with their respective heirs, executors, administrators, successors and assigns, held and firmly bound unto **CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT**, hereinafter "the Oblige," for payment of the penal sum hereof in lawful money of the United States, as more particularly set forth herein.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

WHEREAS, the Principal has submitted the accompanying Bid Proposal to the Oblige for the Work commonly described as the **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project**,

WHEREAS, subject to the terms of this Bond, the Surety is firmly bound unto the Oblige in the penal sum of **ten percent (10%)** of the maximum amount of the Bid Proposal submitted by the Principal to the Oblige, as set forth above.

NOW THEREFORE, if the Principal shall not withdraw said Bid Proposal within the period specified therein after the opening of the same, or, if no period be specified, for sixty (60) days after opening of said Bid Proposal; and if the Principal is awarded the Contract, and shall within the period specified therefor, or if no period be specified, within five (5) days after the prescribed forms are presented to him for signature, enter into a written contract with the Oblige, in accordance with the Bid Proposal as accepted and give such bond(s) with good and sufficient surety or sureties, as may be required, for the faithful performance and proper fulfillment of such Contract and for the payment for labor and materials used for the performance of the Contract, or in the event of the withdrawal of said Bid Proposal within the period specified for the holding open of the Bid Proposal or the failure of the Principal to enter into such Contract and give such bonds within the time specified, if the Principal shall pay the Oblige the difference between the amount specified in said Bid Proposal and the amount for which the Oblige may procure the required Work and/or supplies, if the latter amount be in excess of the former, together with all costs incurred by the Oblige in again calling for Bids, then the above obligation shall be void and of no effect, otherwise to remain in full force and effect.

Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or the Call for Bids, the Work to be performed thereunder, the Drawings or the Specifications accompanying the same, or any other portion of the Contract Documents shall in no way affect its obligations under this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of said Contract, the Call for Bids, the Work, the Drawings or the Specifications, or any other portion of the Contract Documents.

In the event suit or other proceeding is brought upon this Bond by the Oblige, the Surety shall pay to the Oblige all costs, expenses and fees incurred by the Oblige in connection therewith, including without limitation, attorney's fees.

IN WITNESS WHEREOF, the Principal and Surety have executed this instrument this _____ day of _____, 2021 by their duly authorized agents or representatives.

(Principal's Corporate Seal)

(Principal Name)

By: _____

(Typed or Printed Name)

Title: _____

(Surety's Corporate Seal)

(Surety Name)

By: _____
(Signature of Surety)

(Attach Attorney-in-Fact Certificate)

(Typed or Printed Name)

() _____
(Area Code and Telephone Number of Attorney-in-Fact for Surety)

Contact name, address, telephone number and email address for notices to the Surety

(Contact Name)

(Address)

(Telephone)

(Email address)

CERTIFICATION OF PRE-BID SITE VISIT

The Honorable Board of Trustees
Chabot-Las Positas Community College District
7600 Dublin Blvd., 3rd Floor
Dublin, California 94568

RE: BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project

Ladies and Gentlemen:

In connection with submitting a Bid Proposal for the Work described as BID NO.: B20/21-08 Agriculture Science, Horticulture Facility Project, I visited the Site of the Work on Wednesday, February 10, 2021 or Tuesday, February 23, 2021 at 10:00am

on behalf of _____
Bidder Name

to inspect the Site of the proposed work, which will be turned over to the Bidder, if awarded the Contract, in its present condition, with a representative of the Chabot-Las Positas Community College, in order to acquaint the Bidder with the proposed Work so that the Bidder fully understands the facilities, difficulties, and restrictions attendant to execution and completion of the Work. I have also reviewed on behalf of the Bidder, the as-built drawings and/or previous Contract Documents, site conditions and Bid Documents with District representatives and/or Construction Manager for the Project.

I certify all conditions provided for my review and their effect on the Work as called for in the Contract Documents are included and accounted for in the Bid Proposal amounts submitted to the District.

I understand that a Bidder who fails to submit this Certification of Pre-Bid Site Visit, fully executed, with the Bidder's Bid Proposal form, will result in rejection of the Bid Proposal for non-responsiveness.

Name of Bidder

Authorized Signatory

Address

Phone Number

Date

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BID PROPOSAL

TO: **CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT**, a California Community College District, acting by and through its Board of Trustees (“the District”).

FROM:

(Name of Bidder)
(Address)
(City, State, Zip Code)
(Telephone/Fax)
(E-Mail Address of Bidder’s Representative(s))
(Name(s) of Bidder’s Authorized Representative(s))

1. Bid Proposal

1.	Base Bid	\$
2.	Owner’s Non-Specified Allowance	\$ 250,000.00
3.	Total Bid Amount (Sum of Line 1 + 2)	\$

1.1 Bid Proposal Amount. The undersigned Bidder proposes and agrees to perform the Contract including, without limitation, providing and furnishing any and all of the labor, materials, tools, equipment and services necessary to complete in a workmanlike manner all of the Work and other obligations required by the Contract Documents for the sum of _____ Dollars (\$ _____) (Line 4 of Table above). The Bidder confirms that it has checked all of the above figures and understands that neither the District nor any of its agents, employees or representatives shall be responsible for any errors or omissions on the part of the undersigned Bidder in preparing and submitting this Bid Proposal. The Bidder confirms that the bid proposal includes the Owner’s Non-Specified Allowance in the amount of Two Hundred Fifty Thousand Dollars and No Cents (\$250,000.00).

1.2 Owner’s Non-Specified Allowance. Bidder shall include in Bid Proposal the stipulated sum of Two Hundred Fifty Thousand Dollars and No Cents (\$250,000.00) for non-specified work to be performed ONLY at the determination and direction of the District. Work performed at the determination and direction of the District under this Allowance shall be documented by Contractor and submitted to Construction Manager per the

requirements specified in Article 9 of the General Conditions. Contractor shall include a separate line item in Contractor's Schedule of Values as "Allowance" with the value of Two Hundred Fifty Thousand Dollars (\$250,000.00). At closeout of Contract, any funds remaining in the Allowance shall be credited to Owner through a Change Order.

1.3 Acknowledgment of Bid Addenda. The Bidder confirms that this Bid Proposal incorporates and is inclusive of, all items or other matters contained in Bid Addenda issued by or on behalf of the District.

_____ **Addenda Nos.** _____ received, acknowledged
(initial) and incorporated into this Bid Proposal.

2. **Documents Accompanying Bid.** The Bidder has submitted with this Bid Proposal the following: (a) Bid Security; (b) Subcontractors List; (c) Statement of Qualifications; (d) Certification of Pre-Bid Site Visit; (e) Non-Collusion Affidavit; and (f) Public Works Contractor Registration Certification Form. The Bidder acknowledges that if this Bid Proposal and the foregoing documents are not fully in compliance with applicable requirements set forth in the Call for Bids, the Instructions for Bidders and in each of the foregoing documents, the Bid Proposal may be rejected as non-responsive.

3. **Award of Contract.** If the Bidder submitting this Bid Proposal is awarded the Contract, the undersigned will execute and deliver to the District the Contract in the form attached hereto within ten (10) days after notification of award of the Contract. Concurrently with delivery of the executed Agreement to the District, the Bidder awarded the Contract shall deliver to the District: (a) Certificates of Insurance evidencing all insurance coverages required under the Contract Documents; (b) the Performance Bond; (c) the Labor and Material Payment Bond; (d) the Certificate of Workers' Compensation Insurance; and (e) the Drug-Free Workplace Certificate. Failure of the Bidder awarded the Contract to strictly comply with the preceding may result in the District's rescission of the award of the Contract and/or forfeiture of the Bidder's Bid Security. In such event, the District may, in its sole and exclusive discretion elect to award the Contract to the responsible Bidder submitting the next lowest Bid Proposal, or to reject all Bid Proposals.

4. **Contractor's License.** The undersigned Bidder is currently and duly licensed in accordance with the California Contractors License Law, California Business & Professions Code §§7000 et seq., under the following classification(s) _____ bearing License Number(s) _____, with expiration date(s) of _____. The Bidder certifies that: (a) it is duly licensed, in the necessary class(es), for performing the Work of the Contract Documents; (b) that such license shall be in full force and effect throughout the duration of the performance of the Work under the Contract Documents; and (c) that all Subcontractors providing or performing any portion of the Work shall be so properly licensed to perform or provide such portion of the Work.

5. **Acknowledgment and Confirmation.** The undersigned Bidder acknowledges its receipt, review and understanding of the Drawings, the Specifications and other Contract Documents pertaining to the proposed Work. The undersigned Bidder certifies that the Contract Documents are, in its opinion, adequate, feasible and complete for providing, performing and constructing the Work in a sound and suitable manner for the use specified and intended by the Contract Documents. The undersigned Bidder certifies that it has, or has available, all necessary equipment, personnel, materials, facilities and technical and financial ability to complete the Work for the amount bid herein within the Contract Time and in accordance with the Contract Documents.

(Corporate Seal)

By: _____

(Signature)

(Typed or Printed Name)

Title: _____

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AGREEMENT

THIS AGREEMENT is made this ____ day of _____, 2021, in the City of Dublin, County of Alameda, State of California, by and between **CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT**, a California Community College District hereinafter "District" and _____ ("Contractor") doing business at _____.

WITNESSETH, that the District and the Contractor in consideration of the mutual covenants contained herein agree as follows:

1. **The Work.** Within the Contract Time and for the Contract Price, subject to adjustments thereto pursuant to the Contract Documents, the Contractor shall perform and provide all necessary labor, materials, tools, equipment, utilities, services and transportation to complete in a workmanlike manner all of the Work required in connection with the work of improvement commonly referred to as **BID NO.: B20/21-08, Agriculture Sciences, Horticulture Facility Project**. Contractor shall complete all Work covered by the Contract Documents, including without limitation, the Drawings and Specifications prepared by Catalyst Consulting Group and other Contract Documents enumerated in Article 5 below, along with all modifications and addenda thereto issued in accordance with the Contract Documents.
2. **Contract Time.** The Work shall be commenced on the date stated in the District's Notice to Proceed; the Contractor shall achieve Substantial Completion of the Work within the Contract Time set forth in the Contract Documents.
3. **Contract Price.** The District shall pay the Contractor as full consideration for the Contractor's full, complete and faithful performance of the Contractor's obligations under the Contract Documents, subject to adjustments of the Contract Price in accordance with the Contract Documents, the Contract Price of _____ Dollars (\$_____), which includes the Owner's Non-Specified Allowance of \$250,000.00. The Contract Price is based upon the Contractor's Base Bid Proposal.

The District's payment of the Contract Price shall be in accordance with the Contract Documents.

4. **Liquidated Damages.** If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, including adjustments thereto authorized by the Contract Documents, the Contractor shall be subject to assessment of Liquidated Damages in accordance with the Contract Documents. Failure of the Contractor to complete Punchlist items noted upon Substantial Completion within the time established to complete the Punchlist items will result in the District's assessment of Liquidated Damages in accordance with the Contract Documents.
5. **The Contract Documents.** The documents forming a part of the Contract Documents consist of the following, all of which are component parts of the Contract Documents.

Notice to Contractors Calling For Bids	Bid Bond
Instructions For Bidders	Bid Addenda Nos. _____
Bid Proposal	Agreement
Subcontractors List	Performance Bond
Non-Collusion Affidavit	Labor and Materials Payment Bond
Statement of Bidder's Qualifications	Drug-Free Workplace Certification

Certificate of Workers Compensation
Insurance Certification
General Conditions
Special Conditions
Change Order Form
Asbestos and Other Hazardous Materials
Debris Recycling Statement

Certification of Pre-Bid Site Visit
Public Works Contractor Registration
Certification Form
Guarantee
Specifications
Drawings
Project Labor Agreement

6. Authority to Execute. The individual(s) executing this Agreement on behalf of the Contractor is/are duly and fully authorized to execute this Agreement on behalf of Contractor and to bind the Contractor to each and every term, condition and covenant of the Contract Documents.

CONTRACTORS ARE REQUIRED BY LAW TO BE LICENSED AND REGULATED BY THE CONTRACTORS' STATE LICENSE BOARD. ANY QUESTIONS CONCERNING A CONTRACTOR MAY BE REFERRED TO THE REGISTRAR, CONTRACTORS' STATE LICENSE BOARD, P.O. BOX 2600, SACRAMENTO, CALIFORNIA 95826

IN WITNESS WHEREOF, this Agreement has been duly executed by the District and the Contractor as of the date set forth above.

**“DISTRICT”
CHABOT-LAS POSITAS COMMUNITY
COLLEGE DISTRICT**

**“CONTRACTOR”
(CONTRACTOR NAME)**

By: _____
Date

Mr. Jonah Nicholas
Vice Chancellor, Business Services

By: _____
Date

Title: _____

(CORPORATE SEAL)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS that we, _____,
as Principal, and _____ as Surety, are held and firmly bound unto
CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT hereinafter "the Obligee", in the penal
sum of _____ Dollars (\$_____) in lawful money of the United
States, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors
and assigns, jointly and severally.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

WHEREAS, the Obligee, by resolution of its Board of Trustees has awarded to the Principal a
Contract for the Work described as **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility
Project**.

WHEREAS, the Principal, has entered into an agreement with the Obligee for performance of
the Work; the Agreement and all other Contract Documents set forth therein are incorporated herein
and made a part hereof by this reference.

WHEREAS, by the terms of the Contract Documents, the Principal is required to furnish a bond
ensuring the Principal's prompt, full and faithful performance of the Work of the Contract Documents.

NOW THEREFORE, if the Principal shall promptly, fully and faithfully perform each and all of
the obligations and things to be done and performed by the Principal in strict accordance with the terms
of the Contract Documents as they may be modified or amended from time to time; and if the Principal
shall indemnify and save harmless the Obligee and all of its officers, agents and employees from any
and all losses, liability and damages, claims, judgments, liens, costs, and fees of every description,
which may be incurred by the Obligee by reason of the failure or default on the part of the Principal in
the performance of any or all of the terms or the obligations of the Contract Documents, including all
modifications, and amendments, thereto, and any warranties or guarantees required thereunder; then
this obligation shall be void; otherwise, it shall be, and remain, in full force and effect.

The Surety, for value received, hereby stipulates and agrees that no change, adjustment of the
Contract Time, adjustment of the Contract Price, alterations, deletions, additions, or any other
modifications to the terms of the Contract Documents, the Work to be performed thereunder, or to the
Specifications or the Drawings shall limit, restrict or otherwise impair Surety's obligations or Obligee's
rights hereunder; Surety hereby waives notice from the Obligee of any such changes, adjustments of
Contract Time, adjustments of Contract Price, alterations, deletions, additions or other modifications to
the Contract Documents, the Work to be performed under the Contract Documents, or the Drawings or
the Specifications.

In the event of the Obligee's termination of the Contract due to the Principal's breach or default
of the Contract Documents, within thirty (30) days after written notice from the Obligee to the Surety of
the Principal's breach or default of the Contract Documents and Obligee's termination of the Contract,
the Surety shall notify Obligee in writing of Surety's assumption of obligations hereunder by its election
to either remedy the default or breach of the Principal or to take charge of the Work of the Contract
Documents and complete the Work at its own expense ("the Notice of Election"); provided, however,
that the procedure by which the Surety undertakes to discharge its obligations under this Bond shall be
subject to the advance written approval of the Obligee, which approval shall not be unreasonably
withheld, limited or restricted. The insolvency of the Principal or the Principal's mere denial of a failure

of performance or default under the Contract Documents shall not by itself, without the Surety's prompt, diligent inquiry and investigation of such denial, be justification for Surety's failure to give the Notice of Election or for its failure to promptly remedy the failure of performance or default of the Principal or to complete the Work.

In the event the Surety shall fail to issue its Notice of Election to Obligee within the time provided for hereinabove, the Obligee may thereafter cause the cure or remedy of the Principal's failure of performance or default or to complete the Work. The Principal and the Surety shall be each jointly and severally liable to the Obligee for all damages and costs sustained by the Obligee as a result of the Principal's failure of performance under the Contract Documents or default in its performance of obligations thereunder, including without limitation the costs of cure or completion exceeding the then remaining balance of the Contract Price; provided that the Surety's liability hereunder for the costs of performance, damages and other costs sustained by the Obligee upon the Principal's failure of performance under or default under the Contract Documents shall be limited to the penal sum hereof, which shall be deemed to include the costs or value of any Changes to the Work which increases the Contract Price.

In the event suit or other proceeding is brought upon this Bond by the Obligee, the Surety shall pay to the Obligee all costs, expenses and fees incurred by the Obligee therewith, including without limitation, attorneys fees.

IN WITNESS WHEREOF, the Principal and Surety have executed this instrument this ____ day of _____, 2021 by their duly authorized agent or representative.

(Principal's Corporate Seal)

(Principal Name)

By: _____

(Typed or Printed Name)

Title: _____

(Surety's Corporate Seal)

(Surety Name)

By: _____
(Signature of Attorney-in-Fact for Surety)

(Attach Attorney-in-Fact Certificate)

(Typed or Printed Name)

() _____
(Area Code and Telephone Number of Attorney-in-Fact for Surety)

Contact name, address, telephone number and email address for notices to the Surety

(Contact Name)

(Address)

(Telephone)

(Email address)

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS that we, _____
as Principal, and _____ as
Surety, are held and firmly bound unto **CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT**
hereinafter "the Obligee", in the penal sum of _____ Dollars
(\$_____) in lawful money of the United States, well and truly to be made, we bind ourselves,
our heirs, executors, administrators, successors and assigns, jointly and severally.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

WHEREAS, the Obligee, by resolution of its Board of Trustees has awarded to the Principal a
Contract for the Work described as **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility
Project.**

WHEREAS, the Principal, has entered into an Agreement with the Obligee for performance of
the Work, the Agreement and all other Contract Documents set forth therein are incorporated herein by
this reference and made a part hereof.

WHEREAS, by the terms of the Contract Documents, the Principal is required to furnish a bond
for the prompt, full and faithful payment to any Claimant, as hereinafter defined, for all labor materials
or services used, or reasonably required for use, in the performance of the Work.

NOW THEREFORE, if the Principal shall promptly, fully and faithfully make payment to any
Claimant for all labor, materials or services used or reasonably required for use in the performance of
the Work then this obligation shall be void; otherwise, it shall be, and remain, in full force and effect.

The term "Claimant" shall refer to any person, corporation, partnership, proprietorship or other
entity including without limitation, all persons and entities described in California Civil Code §3181,
providing or furnishing labor, materials or services used or reasonably required for use in the
performance of the Work under the Contract Documents, without regard for whether such labor,
materials or services were sold, leased or rented. This Bond shall inure to the benefit of all Claimants
so as to give them, or their assigns and successors, a right of action upon this Bond.

In the event suit is brought on this Bond by any Claimant for amounts due such Claimant for
labor, materials or services provided or furnished by such Claimant, the Surety shall pay for the same
and reasonable attorneys fees pursuant to California Civil Code §3250.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time,
alteration, deletion, addition, or any other modification to the terms of the Contract Documents, the Work
to be performed thereunder, the Specifications or the Drawings, or any other portion of the Contract
Documents, shall in any way limit, restrict or otherwise affect its obligations under this Bond; the Surety
hereby waives notice from the Obligee of any such change, extension of time, alteration, deletion,
addition or other modification to the Contract Documents, the Work to be performed under the Contract
Documents, the Drawings or the Specifications of any other portion of the Contract Documents.

IN WITNESS WHEREOF, the Principal and Surety have executed this instrument this _____ day of _____, 2021 by their duly authorized agent or representative.

(Principal's Corporate Seal)

(Principal Name)

By: _____
(Signature)

(Type or Print Name)

Title: _____

(Surety's Corporate Seal)

(Surety Name)

By: _____
(Signature of Attorney-in-Fact for Surety)

(Type or Print Name of Attorney-in-Fact)

(Attach Attorney-in-Fact Certificate)

() _____
(Area Code and Telephone Number of Attorney-in-Fact for Surety)

Contact name, address, telephone number and email address for notices to the Surety

(Contact Name)

(Address)

(Telephone)

(Email address)

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CERTIFICATE OF WORKERS' COMPENSATION INSURANCE

PROJECT: BID NO.: 20/21-08, Agriculture Science, Horticulture Facility Project

I, _____ the _____ of
(Name) (Title)

_____, declare, state and certify that:
(Contractor Name)

1. I am aware that California Labor Code §3700(a) and (b) provides:

“Every employer except the state shall secure the payment of compensation in one or more of the following ways:

- (a) By being insured against liability to pay compensation in one or more insurers duly authorized to write compensation insurance in this state.
- (b) By securing from the Director of Industrial Relations a certificate of consent to self-insure either as an individual employer, or one employer in a group of employers, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his or her employees.”

2. I am aware that the provisions of California Labor Code §3700 require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of this Contract.

(Contractor Name)

By: _____
(Signature)

(Typed or printed name)

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DRUG-FREE WORKPLACE CERTIFICATION

PROJECT: BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project

I, _____, am the _____ of
(Print Name) (Title)

_____. I declare, state and certify to all of the following:
(Contractor Name).

1. I am aware of the provisions and requirements of California Government Code §§8350 et seq., the Drug Free Workplace Act of 1990.
2. I am authorized to certify, and do certify, on behalf of Contractor that a drug free workplace will be provided by Contractor by doing all of the following:
 - A. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance is prohibited in Contractor's workplace and specifying actions which will be taken against employees for violation of the prohibition;
 - B. Establishing a drug-free awareness program to inform employees about all of the following:
 - i. The dangers of drug abuse in the workplace;
 - ii. Contractor's policy of maintaining a drug-free workplace;
 - iii. The availability of drug counseling, rehabilitation and employee-assistance programs; and
 - iv. The penalties that may be imposed upon employees for drug abuse violations;
 - C. Requiring that each employee engaged in the performance of the Contract be given a copy of the statement required by subdivision (A), above, and that as a condition of employment by Contractor in connection with the Work of the Contract, the employee agrees to abide by the terms of the statement.
 - D. Contractor agrees to fulfill and discharge all of Contractor's obligations under the terms and requirements of California Government Code §8355 by, inter alia, publishing a statement notifying employees concerning: (a) the prohibition of any controlled substance in the workplace, (b) establishing a drug-free awareness program, and (c) requiring that each employee engaged in the performance of the Work of the Contract be given a copy of the statement required by California Government Code §8355(a) and requiring that the employee agree to abide by the terms of that statement.
3. Contractor and I understand that if the District determines that Contractor has either: (a) made a false certification herein, or (b) violated this certification by failing to carry out and to implement the requirements of California Government Code §§8355, the Contract awarded herein is subject to termination, suspension of payments, or both. Contractor and I further understand that, should Contractor violate the terms of the Drug-Free Workplace Act of 1990, Contractor may be subject to debarment in accordance with the provisions of California Government Code §§8350, et seq.
4. Contractor and I acknowledge that Contractor and I are aware of the provisions of California Government Code §§8350, et seq. and hereby certify that Contractor and I will adhere to, fulfill, satisfy and discharge all provisions of and obligations under the Drug-Free Workplace Act of 1990.

I declare under penalty of perjury under the laws of the State of California that all of the foregoing is true and correct.

Executed at _____ this ____ day of _____, 2021
(City and State)

(Signature)

(Handwritten or Typed Name)

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GENERAL CONDITIONS

ARTICLE 1: DEFINITIONS; GENERAL

- 1.1 District.** The “District” refers to CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT and unless otherwise stated, includes the District's authorized representatives, including the Construction Manager, if a Construction Manager is designated, the District's Board of Trustees and the District’s officers, employees, agents and representatives.
- 1.2 Contractor.** The Contractor is the person or entity identified as such in the Agreement; references to “Contractor” include the Contractor's authorized representative.
- 1.3 Architect.** The Architect is the person or entity identified as such in the Agreement; references to the “Architect” include the Architect's authorized representative.
- 1.4 The Work.** The “Work” is the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment or services provided or to be provided by the Contractor to fulfill the Contractor's obligations under the Contract Documents. The Work may constitute the whole or a part of the Project.
- 1.5 The Project.** The Project is the total construction of which the Work performed by the Contractor under the Contract Documents which may be the whole or a part of the Project and which may include construction by the District or by separate contractors.
- 1.6 Surety.** The Surety is the person or entity that executes, as surety, the Contractor's Labor and Material Payment Bond and/or Performance Bond.
- 1.7 Subcontractors; Sub-Subcontractors.** A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work. “Subcontractor” does not include a separate contractor to the District or subcontractors of any separate contractor. A Sub-Subcontractor is a person or entity of any tier, who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site.
- 1.8 Material Supplier.** A Material Supplier is any person or entity who only furnishes materials, equipment or supplies for the Work without fabricating, installing or consuming them in the Work.
- 1.9 Drawings and Specifications.** The Drawings are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing generally, the design, location and dimensions of the Work and may include without limitation, plans, elevations, sections, details, schedules or diagrams. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, criteria and workmanship for the Work and related services. The Drawings and Specifications are intended to delineate and describe the Work and its component parts so as to permit skilled and competent contractors to bid upon the Work and prosecute the same to completion. Large scale Drawings shall take precedence over smaller scale Drawings as to shape and details of construction. Figured dimensions on Drawings shall govern, but Work which is not dimensioned shall be as directed or required by field conditions. Specifications shall govern as to materials, workmanship and installation procedures.

1.10 Special Conditions; Supplemental Conditions. If made a part of the Contract Documents, Special Conditions and Supplemental Conditions are special or supplemental provisions, not otherwise provided for in the Agreement or the General Conditions.

1.11 Contract Documents. The Contract Documents consist of the Agreement between the District and the Contractor, Conditions of the Contract (whether General, Special, Supplemental or otherwise), Drawings, Specifications, including addenda thereto issued prior to execution of the Agreement and any other documents listed in the Agreement. The Contract Documents shall include modifications issued after execution of the Agreement. The Contract Documents form the Contract for Construction.

1.12 Intent and Correlation of Contract Documents.

1.12.1 Work of the Contract Documents. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable therefrom as being necessary to produce the intended results. Organization of the Specifications into divisions, sections or articles, and the arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Where any portion of the Contract Documents is silent and information appears elsewhere in the Contract Documents, such other portions of the Contract Documents shall control.

1.12.2 Technical Terms. Unless otherwise stated in the Contract Documents, words or terms which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.12.3 Conflict in Contract Documents. Conflicts, inconsistencies or ambiguities in the Contract Documents shall be resolved by the Architect in accordance with Article 3.1.9 of the General Conditions; where conflicts or inconsistencies arise between the Drawings and the Specifications, in resolving such conflicts or inconsistencies, the Architect will be governed generally by the following standards: the Drawings are intended to describe matters relating to placement, type, quantity and the like; the Specifications are intended to describe matters relating to quality, materials, compositions, manufacturers and the like. If conflicts exist between portions of the Contract Documents regarding the quality of any item, product, equipment or materials, unless otherwise directed or authorized by the District, the Contractor shall provide the item, product, equipment or material of the highest or more stringent quality.

1.13 Shop Drawings; Samples; Product Data (“Submittals”). Shop Drawings are diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-Subcontractor, manufacturer, Material Supplier, or distributor to illustrate some portion of the Work. Samples are physical examples of materials, equipment or workmanship forming a part of, or to be incorporated into the Work. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work. Shop Drawings, Samples and Product Data prepared or furnished by the

Contractor or any of its Subcontractors or Material Suppliers are collectively referred to as "Submittals".

- 1.14 Division of State Architect ("DSA").** The DSA is the California Division of the State Architect including without limitation the DSA's Office of Construction Services, Office of Design Services and the Office of Regulatory Services; references to the DSA in the Contract Documents shall mean the DSA, its offices and its authorized employees and agents. The authority of the DSA over the Work and the performance thereof shall be as set forth in the Contract Documents and Title 24 of the California Code of Regulations.
- 1.15 Project Inspector.** The Project Inspector is the individual designated and employed by the District in accordance with the requirements of Title 24 of the California Code of Regulations. The Project Inspector shall be authorized to act on behalf of the District as provided for in the Contract Documents and in Title 24 of the California Code of Regulations, as the same may be amended from time to time.
- 1.16 Contract Document Terms.** The term "provide" means "provide complete in place" or to "furnish and install" such item. Unless otherwise provided in the Contract Documents, the terms "approved;" "directed;" "satisfactory;" "accepted;" "acceptable;" "proper;" "required;" "necessary" and "equal" shall mean as approved, directed, satisfactory, accepted, acceptable, proper, required, necessary and equal, in the opinion of the Architect. The term "typical" as used in the Drawings shall require the installation or furnishing of such item(s) of the Work designated as "typical" in all other areas similarly marked as "typical"; Work in such other areas shall conform to that shown as "typical" or as reasonably inferable therefrom.
- 1.17 Contractor's Superintendent.** The Contractor's Superintendent is the individual employed by the Contractor whose principal responsibility shall be the supervision and coordination of the Work; the Contractor's Superintendent shall not perform routine construction labor.
- 1.18 Record Drawings.** The Record Drawings are a set of the Drawings marked by the Contractor during the performance of the Work to indicate completely and accurately the actual as-built condition of the Work. The Record Drawings shall be sufficient for a capable and qualified draftsman to modify the Drawings to reflect and indicate the Work actually in place at Final Completion of the Work.
- 1.19 Construction Manager.** The Construction Manager is an independent contractor retained by the District and is authorized and empowered to act on behalf of the District as set forth in the Contract Documents. The District reserves the right to remove or replace the Construction Manager prior to completion of the Work without adjustment of the Contract Price or the Contract Time or otherwise affect, limit or restrict Contractor's obligations hereunder.
- 1.20 Construction Equipment.** "Construction Equipment" is equipment utilized for the performance of any portion of the Work, but which is not incorporated into the Work.
- 1.21 Site.** The Site is the physical area designated in the Contract Documents for Contractor's performance, construction and installation of the Work.
- 1.22 Field Clarifications.** A written or graphic document consisting of supplementary details, instructions or information issued on behalf of the District which clarifies or supplements the Contract Documents and which becomes a part of the Contract Documents upon issuance. Field Clarifications do not constitute an adjustment of the Contract Time or the Contract Price,

unless a Change Order relating to a Field Clarification is authorized and issued under the Contract Documents.

- 1.23 Defective or Non-Conforming Work.** Defective or non-conforming Work is any Work which is unsatisfactory, faulty or deficient by: (a) not conforming to the requirements of the Contract Documents; (b) not conforming to the standards of workmanship of the applicable trade or industry; (c) not being in compliance with the requirements of any inspection, reference, standard, test, or approval required by the Contract Documents; or (d) damage occurring prior to Final Completion of all of the Work.
- 1.24 Delivery.** The term “delivery” used in conjunction with any equipment, materials or other items to be incorporated into the Work shall mean the unloading and storage in a protected condition pending incorporation into the Work.
- 1.25 Notice to Proceed.** The Notice to Proceed is the written notice issued by or on behalf of the District to the Contractor authorizing the Contractor to proceed with commencement of the Work and which establishes the date for commencement of the Contract Time.
- 1.26 Progress Reports; Verified Reports.** Progress Reports, if required, are written reports prepared by the Contractor and periodically submitted to the District in the form and content as required by the Contract Documents. Verified Reports are periodic written reports prepared by the Contractor and submitted to the DSA; Verified Reports shall be in such form and content as required by the applicable provisions of Title 24 of the California Code of Regulations. A material obligation of the Contractor is the preparation of complete and accurate Progress Reports, if required, and Verified Reports as well as the timely submission of the same.

ARTICLE 2: DISTRICT

2.1 Information Required of District.

- 2.1.1 Surveys; Site Information.** Information, if any, concerning physical characteristics of the Site, including without limitation, surveys, soils reports, and utility locations, to be provided by the District are set forth in the Contract Documents. Information not provided by the District or necessary information in addition to that provided by the District concerning physical characteristics of the Site which is required shall be obtained by Contractor without adjustment to the Contract Price or the Contract Time.
- 2.1.2 Permits; Fees.** Except as otherwise provided in the Contract Documents, the District shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities which relate to the Work of the Contractor under the Contract Documents. If permits and fees are designated as the responsibility of the Contractor under the Contract Documents, the Contractor shall be solely responsible for obtaining the same; the cost of such permits or fees and any costs incurred by the Contractor in obtaining such permits shall be included within the Contract Price.
- 2.1.3 Drawings and Specifications.** Except as otherwise provided for in the Contract Documents, the District shall furnish the Contractor, free of charge, the number of copies of the Drawings and the Specifications as set forth in the Special Conditions. All of the

Drawings and the Specifications provided by the District to the Contractor remain the property of the District; the Contractor shall not use the Drawings or the Specifications in connection with any other work of improvement other than the Work of the Project.

2.1.4 Furnishing of Information. Information or services to be provided by the District under the Contract Documents shall be furnished by the District with reasonable promptness to avoid delay in the orderly progress of the Work. Information about existing conditions furnished by the District under the Contract Documents is obtained from sources believed to be reliable, but the District neither guarantees nor warrants that such information is complete and accurate. The Contractor shall verify all information provided by the District. To the extent that the Contract Documents depict existing conditions on or about the Site, or the Work involves the renovation, removal or remodeling of existing improvements or the Work involves any tie-in or other connection with any existing improvements, the conditions and/or existing improvements depicted in the Contract Documents are as they are believed to exist. Contractor shall bear the risk of any variations between conditions or existing improvements depicted in the Contract Documents and those conditions or existing improvements actually encountered in the performance of the Work. Subject to the provisions of Article 4.2.3, the existence of any variations between conditions or existing improvements depicted in the Contract Documents and those actually encountered in the performance of the Work shall not result in any District liability therefor, nor shall any such variations result in an adjustment of the Contract Time or the Contract Price.

2.2 District's Right to Stop the Work. In addition to the District's right to suspend the Work or terminate the Contract pursuant to the Contract Documents, the District, may, by written order, direct the Contractor to stop the Work, or any portion thereof, until the cause for such stop work order has been eliminated if the Contractor. If the Contractor fails within seven (7) days to correct Work which is not in conformity and in accordance with the requirements of the Contract Documents, or (ii) otherwise fails to carry out the Work in conformity and accordance with the Contract Documents, the District reserves the right to remedy such action. The right of the District to stop the Work hereunder shall not be deemed a duty on the part of the District to exercise such right for the benefit of the Contractor or any other person or entity, nor shall the District's exercise of such right waive or limit the exercise of any other right or remedy of the District under the Contract Documents or at law.

2.3 Partial Occupancy or Use.

2.3.1 District's Right to Partial Occupancy. The District may occupy or use any completed or partially completed portion of the Work, provided that: (i) the District has obtained the consent of, or is otherwise authorized by, public authorities with jurisdiction thereof, to so occupy or use such portion of the Work and (ii) the District and the Contractor have accepted, in writing, the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, utilities, damage to the Work, insurance and the period for correction of the Work and commencement of warranties required by the Contract Documents for such portion of the Work partially used or occupied by the District. If the Contractor and the District are unable to agree upon the matters set forth in (ii) above, the District may nevertheless use or occupy any portion of the Work, with the responsibility for such matters subject to resolution in accordance with the Contract Documents. Immediately prior to such partial occupancy or use of the Work, or portions thereof, the District, the Project Inspector, the Contractor and the Architect shall jointly inspect the portions of the Work to be occupied or to be used to determine and record the condition of

the Work. Repairs, replacements or other corrective action noted in such inspection shall be promptly performed and completed by the Contractor so that the portion of the Work to be occupied or used by the District is in conformity with the requirements of the Contract Documents and the District's occupancy or use thereof is not impaired. The District's use or occupancy of the Work or portions thereof pursuant to the preceding shall not be deemed "completion" of the Work as that term is used in Public Contract Code §7107.

2.3.2 No Acceptance of Defective or Nonconforming Work. Unless otherwise expressly agreed upon by the District and the Contractor, the District's partial occupancy or use of the Work or any portion thereof, shall not constitute the District's acceptance of the Work not complying with the requirements of the Contract Documents or which is otherwise defective.

2.4 The Project Inspector. In addition to the authority and rights of the Project Inspector as provided for elsewhere in the Contract Documents, all of the Work shall be performed under the observation of the Project Inspector. The performance of the duties of the Project Inspector under the Contract Documents shall not relieve or limit the Contractor's performance of its obligations under the Contract Documents.

2.4.1 Access to Work. The Contractor shall provide the Project Inspector with access to all parts of the Work at any time, wherever located and whether partially or completely fabricated, manufactured, furnished or installed. The Project Inspector shall have the authority to stop Work if the Work is not in conformity with the Contract Documents.

2.4.2 Limitations on Project Inspector. The Project Inspector does not have authority to interpret the Contract Documents or to modify the Work depicted in the Contract Documents. No Work inconsistent with the Contract Documents shall be performed solely on the basis of the direction of the Project Inspector, and the Contractor shall be liable to the District for the consequences of all Work performed on such basis.

ARTICLE 3: ARCHITECT; CONSTRUCTION MANAGER

3.1 Administration of the Contract.

3.1.1 Role of the Architect and Construction Manager. The Architect and the Construction Manager will provide administration of the Contract as described in the Contract Documents, and will be the District's representatives during construction until the time that Final Payment is due the Contractor under the Contract Documents. The Architect and Construction Manager will advise and consult with the District and the Project Inspector with respect to the administration of the Contract and the Work. The Architect is authorized to act on behalf of the District to the extent provided for in the Contract Documents; and shall have the responsibilities and powers established by law, including Title 24 of the California Code of Regulations. The Architect and Construction Manager are authorized to stop the Work whenever deemed necessary in the sole discretion of the Architect or the Construction Manager to insure that the Work is completed in accordance with the Contract Documents.

3.1.2 Architect's Periodic Site Visits. The Architect will visit the Site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work and to determine, in general, if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract

Documents. The Architect will not be required to make exhaustive or continuous Site inspections to check quality or quantity of the Work. On the basis of Site observations as an architect, the Architect will keep the District informed of the progress of the Work, and will endeavor to guard the District against defects and deficiencies in the Work.

3.1.3 Contractor Responsibility for Construction Means, Methods and Sequences.

Neither the Architect or the Construction Manager will have control over or charge of and be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, these being solely the Contractor's responsibility. Neither the Architect nor Construction Manager will have control over or charge of and be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or of any other persons performing portions of the Work.

3.1.4 Review of Applications for Payment. In accordance with Article 8 hereof, the Architect and Construction Manager will review the Contractor's Applications for Progress Payments and for Final Payment, evaluate the extent of Work performed and the amount properly due the Contractor on such Application for Payment.

3.1.5 Rejection of Work. The Architect is authorized to reject Work which is defective or does not conform to the requirements of the Contract Documents. Whenever the Architect considers it necessary or advisable, for implementation of the intent of the Contract Documents, the Architect will have authority to require additional inspections or testing of the Work, whether or not such Work is fabricated, installed or completed. Neither this authority of the Architect nor a decision made in good faith by the Architect to exercise or not to exercise such authority shall give rise to a duty or responsibility to the Contractor, Subcontractors, Material Suppliers, their agents or employees, or other persons performing portions of the Work.

3.1.6 Submittals.

3.1.6.1 Processing of Submittals Through Construction Manager. Submittals required by the Contract Documents shall be prepared by or on behalf of the Contractor in accordance with the requirements of the Contract Documents. Submittals shall be transmitted by the Contractor to the Construction Manager for distribution by the Construction Manager to the Architect and the District. Upon completion of the Architect's review of a Submittal, the Construction Manager shall transmit the reviewed Submittal to the Contractor for the Contractor's distribution to its Subcontractor(s) and other affected parties.

3.1.6.2 Architect's Review. The Architect will review and approve or take other appropriate action upon the Contractor's Submittals, but only for the limited purpose of checking for general conformance with information given and the design concept expressed in the Contract Documents. Review of Submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's Submittals shall not relieve the Contractor of its obligations under the Contract Documents. The Architect's review of Submittals shall not constitute approval of safety measures, programs or precautions or, unless otherwise

specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item in a Submittal shall not indicate approval of an assembly of which the item is a component with the Submittal(s) required and relating to such assembly have been reviewed by the Architect.

3.1.6.3 Time for Architect's Review. The Architect's review of Submittals will be conducted promptly so as not to delay or hinder the progress of the Work or the activities of the Contractor, the District or the District's separate contractors while allowing sufficient time, in the Architect's reasonable professional judgment, to permit adequate review of Submittals. The foregoing notwithstanding, the Architect's review and return of Submittals will conform with the time limits and other conditions, if any, set forth in the Specifications or the Submittal Schedule if the Submittal Schedule is required by other provisions of the Contract Documents.

3.1.7 Changes to the Work; Change Orders. The Architect and Construction Manager will prepare Change Orders, and with the written approval of the District, may authorize minor Changes in the Work which do not result in adjustment of the Contract Time or the Contract Price.

3.1.8 Completion. The Architect will conduct observations to determine the date(s) of Substantial Completion and the date(s) of Final Completion, will receive and forward to the District, for the District's review and records, written warranties and related documents required by the Contract Documents and assembled by the Contractor, and will verify that the Contractor has complied with all requirements of the Contract Documents and is entitled to receipt of Final Payment.

3.1.9 Interpretation of Contract Documents; Architect as Initial Arbiter of Disputes. The Architect will interpret and decide matters concerning the requirements of the Contract Documents on written request of either the District or the Contractor. The Architect's response to such requests will be made with reasonable promptness and within the time limits agreed upon, if any. If no agreement is reached establishing the time for the Architect's review and response to requests under this Article 3.1.9, the Architect shall be afforded a fifteen (15) day period after receipt of such request to review and respond thereto. Interpretations and decisions of the Architect will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both the District and the Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions so rendered in good faith. The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents. If there is any disagreement, dispute or other matter in controversy between the District and the Contractor, in addition to other requirements established by the Contract Documents or by law, the submission of the same to the Architect for its decision shall be a condition precedent to initiation of dispute resolution procedures.

3.1.10 Request for Information. If the Contractor encounters any condition which the Contractor believes, in good faith and with reasonable basis, is the result of an ambiguity, conflict, error or omission in the Contract Documents (collectively "the Conditions"), it shall be affirmative obligation of the Contractor to timely notify the Architect, in writing, of the Conditions encountered and to request information from the Architect necessary to

address and resolve any such Conditions before proceeding with any portion of the Work affected or which may be affected by such Conditions. If the Contractor fails to timely notify the Architect in writing of any Conditions encountered and the Contractor proceeds to perform any portion of the Work containing or affected by such Conditions the Contractor shall bear all costs associated with or required to correct, remove, or otherwise remedy any portion of the Work affected thereby without adjustment of the Contract Time or the Contract Price. In requesting information of the Architect to address and resolve any Conditions the Contractor shall act with promptness in submitting any such written request so as to allow the Architect a reasonable period of time to review, evaluate and respond to any such request, taking into account the then current status of the progress and completion of the Work and the actual or potential impact of any such Conditions upon the completion of the Work within the Contract Time. The Contract Time shall not be subject to adjustment in the event that the Contractor shall fail to timely request information from the Architect. The Architect's responses to any such Contractor request for information shall conform to the standards and time frame set forth in Article 3.1.9 of these General Conditions. The foregoing provisions notwithstanding, in the event that the Architect reasonably determines that any of Contractor's request(s) for information: (i) does not reflect adequate or competent supervision or coordination by the Contractor or any Subcontractor; or (ii) does not reflect the Contractor's adequate or competent knowledge of the requirements of the Work or the Contract Documents; or (iii) is not justified for any other reason, Contractor shall be liable to the District for all costs incurred by the District associated with the processing, reviewing, evaluating and responding to any such request for information, including without limitation, fees of the Architect and any other design consultant to the Architect or the District. In responding to any of Contractor's request(s) for information, the Architect shall, in the response, indicate if the Architect has made the determination pursuant to the preceding sentence and, if so, the amount of costs to be borne by the Contractor for the processing, review, evaluation and response to the request for information. Thereafter, the District is authorized to deduct such amount from any portion of the Contract Price then or thereafter due the Contractor.

3.1.11 Detail Drawings and Instructions.

3.1.11.1 Architect's Additional Details. In case of ambiguity, conflict, or lack of information, Architect shall furnish additional instructions by means of drawings or otherwise, necessary for proper execution of the Work. All such drawings and instructions shall be consistent with Contract Documents, true developments thereof, and reasonably inferable therefrom. Such additional instructions shall be furnished with reasonable promptness, but not more than fourteen (14) days, provided that Contractor informs Architect and District in writing of the relationship of the requested critical path of the Construction Schedule. Architect will furnish necessary additional details to more fully explain the Work, which details shall be deemed part of the Contract Documents.

3.1.11.2 Contractor Notice of Impacts. If the Contractor believes that detail drawings issued by the Architect reflects a change to the scope of work or additional work beyond that reflected in the Contract Documents or reasonably referable therefrom, the Contractor shall give written notice thereof to Architect and District within five (5) days of the receipt of same. If the Contractor does not give the Architect and District such written notice within five (5) days, the details shall be deemed to be reasonable development of the Work depicted in the Contract Documents without adjustment of the Contract Time or the Contract Price. If notice is given by the Contractor, the

Contractor shall set forth in detail the extent of Contract Price or Contract Time adjustments resulting from such details along with the basis upon which the requested Contract Time/Contract Price adjustment is computed. The Architect will review any such notice and request for adjustment of the Contract Time/Contract Price and render the Architect's decision in accordance with the Contract Documents.

- 3.2 Communications; Role of Construction Manager and Architect.** All communications regarding the Work, the performance thereof or the Contract Documents shall be in writing; verbal communications shall be reduced to writing. Communications between the Contractor and the District or the Architect shall be through the Construction Manager. Communications between separate contractors, if any, shall be through the Construction Manager. All written communications between the Contractor and any Subcontractor, Material Supplier or others directly or indirectly engaged by the Contractor to perform or provide any portion of the Work shall be available to the District, the Construction Manager and the Architect for review, inspection and reproduction as may be requested from time to time. Failure or refusal of the Contractor to permit the District, the Construction Manager or Architect to review, inspect or reproduce such written communications may be deemed a default of Contractor hereunder.
- 3.3 Termination of Architect or Construction Manager; Substitute Architect or Construction Manager.** In case of termination of employment of the Architect or the Construction Manager, the District shall appoint a substitute architect or substitute construction manager whose status under the Contract Documents shall be that of the Architect or the Construction Manager, as applicable.

ARTICLE 4: THE CONTRACTOR

4.1 Contractor Review of Contract Documents.

- 4.1.1 Examination of Contract Documents.** The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the District pursuant to the Contract Documents and shall at once report to the Architect any errors, inconsistencies or omissions discovered. If the Contractor performs any Work knowing, or with reasonable diligence should have known that, it involves an error, inconsistency or omission in the Contract Documents without prior notice to the Architect of the same, the Contractor shall assume full responsibility for such performance and shall bear all attributable costs for correction of the same.
- 4.1.2 Field Measurements.** Prior to commencement of the Work, or portions thereof, the Contractor shall take field measurements and verify field conditions at the Site and shall carefully compare such field measurements and conditions and other information known to the Contractor with information provided in the Contract Documents. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.
- 4.1.3 Dimensions; Layouts and Field Engineering.** Unless otherwise expressly provided, dimensions indicated in the Drawings are intended for reference only. The Drawings are intended to be diagrammatic and schematic in nature; the Contractor shall be solely responsible for coordinating the Work of the Contract Documents. All field engineering required for laying out the Work and establishing grades for earthwork operations shall be by the Contractor at its expense. Any field engineering or other engineering to be provided

or performed by the Contractor under the Contract Documents and required or necessary for the proper execution or installation of the Work shall be provided and performed by the an engineer duly registered under the laws of the State of California in the engineering discipline for such portion of the Work. Upon commencement of any item of the Work, the Contractor is responsible for dimensions of such item of Work and related Work; without adjustment of the Contract Time or Contract Price, the Contractor is responsible for making component parts of the Work fit together properly.

4.1.4 Work in Accordance With Contract Documents. The Contractor shall perform all of the Work in strict conformity with the Contract Documents and approved Submittals.

4.2 Site Investigation; Subsurface Conditions.

4.2.1 Contractor Investigation. The Contractor shall be responsible for, and by executing the Agreement acknowledges, that it has carefully examined the Site and has taken all steps it deems reasonably necessary to ascertain all conditions which may effect the Work, or the cost thereof, including, without limitation, conditions bearing upon transportation, disposal, handling or storage of materials; availability of labor and materials; access to the Site; and the physical conditions and the character of equipment, materials, labor and services necessary to perform the Work. Any failure of the Contractor to do so will not relieve it from the responsibility for fully and completely performing all Work without adjustment to the Contract Price or the Contract Time. The District assumes no responsibility to the Contractor for any understandings or representations concerning conditions or characteristics of the Site, or the Work, made by any of its officers, employees or agents prior to the execution of the Agreement, unless such understandings or representations are expressly set forth in the Agreement.

4.2.2 Subsurface Data. By executing the Agreement, the Contractor acknowledges that it has examined the boring data and other subsurface data available and satisfied itself as to the character, quality and quantity of surface and subsurface materials, including without limitation, obstacles which may be encountered in performance of the Work, insofar as this information is reasonably ascertainable from an inspection of the Site, review of available subsurface data and analysis of information furnished by the District under the Contract Documents. Subsurface data or other soils investigation report provided by the District hereunder are not a part of the Contract Documents. Information contained in such data or report regarding subsurface conditions, elevations of existing grades, or below grade elevations are approximate only and is neither guaranteed or warranted by the District to be complete and accurate. The Contractor shall examine all boring and other subsurface data to make its own independent interpretation of the subsurface conditions and acknowledges that its bid is based upon its own opinion of the conditions which may be encountered.

4.2.3 Subsurface Conditions. If the Work under the Contract Documents involves digging trenches or other excavations that extend deeper than four feet below the surface, the Contractor shall promptly and before the following conditions are disturbed, notify the Project Inspector, in writing, of any: (i) material that the Contractor believes may be material that is hazardous waste, as defined in California Health and Safety Code §25117, that is required to be removed to a Class I or Class II or Class III disposal site in accordance with provisions of existing law; (ii) subsurface or latent physical conditions at the site differing from those indicated; or (iii) unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent

in the Work or the character provided for in the Contract Documents. If upon notice to the District of the conditions described above and upon the District's investigation thereof, the District determines that the conditions so materially differ or involve such hazardous materials which require an adjustment to the Contract Price or the Contract Time, the District shall issue a Change Order in accordance with Article 9 hereof. In accordance with California Public Contract Code §7104, any dispute arising between the Contractor and the District as to any of the conditions listed in (i), (ii) or (iii) above, shall not excuse the Contractor from the completion of the Work within the Contract Time and the Contractor shall proceed with all Work to be performed under the Contract Documents. The District reserves the right to terminate the Contract pursuant to Article 15.2 hereof should the District determine not to proceed because of any condition described in (i), (ii) or (iii) above.

4.3 Supervision and Construction Procedures.

4.3.1 Supervision of the Work. The Contractor shall supervise and direct performance of the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract Documents, unless Contract Documents give other specific instructions concerning these matters. The Contractor shall be responsible for inspection of completed or partially completed portions of Work to determine that such portions are in proper condition to receive subsequent Work.

4.3.2 Responsibility for the Work. The Contractor shall be responsible to the District for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and all other persons performing any portion of the Work under a contract with the Contractor. The Contractor shall not be relieved of the obligation to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager, Project Inspector or the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

4.3.3 Layouts. The Contractor is solely responsible for laying-out the Work so that construction of the Work conforms to the requirements of the Contract Documents and so that all component parts of the Work are coordinated. The Contractor shall be responsible for maintenance and preservation of benchmarks, reference points and stakes for the Work. The cost of maintenance and preservation of benchmarks, reference points and stakes shall be included within the Contract Price. The Contractor shall be solely responsible for all loss or costs resulting from the loss, destruction, disturbance or damage of benchmarks, reference points or stakes.

4.3.4 Construction Utilities. The District will furnish and pay the costs of utility services for the Work as set forth in the Special Conditions; all other utilities necessary to complete the Work and to completely perform all of the Contractors' obligations shall be obtained by the Contractor without adjustment of the Contract Price. The Contractor shall furnish and install necessary or appropriate temporary distributions of utilities, including utilities furnished by the District. Any such temporary distributions shall be removed by the Contractor upon completion of the Work. The costs of all such utility services, including the installation and removal of temporary distributions thereof, shall be borne by the Contractor and included in the Contract Price.

4.3.5 Existing Utilities; Removal, Relocation and Protection. In accordance with California Government Code §4215, the District shall assume the responsibility for the timely removal, relocation, or protection of existing main or trunkline utility facilities located on the Site which are not identified in the Drawings, Specifications or other Contract Documents. Contractor shall be compensated for the costs of locating, repairing damage not due to the Contractor's failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Drawings, Specifications and other Contract Documents with reasonable accuracy and for equipment on the Site necessarily idled during such work. Contractor shall not be assessed Liquidated Damages for delay in completion of the Work when such delay is caused by the failure of the District or the District of the utility to provide for removal or relocation of such utility facilities. Nothing in this Article 4.3.5 shall be deemed to require the District to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the Site can be inferred from the presence of other visible facilities, such as buildings, meters and junction boxes, on or adjacent to the Site. If the Contractor encounters utility facilities not identified by the District in the Drawings, Specifications, or other Contract Documents, the Contractor shall immediately notify, in writing, the District, the Project Inspector, the Architect, the Construction Manager and the utility owner. In the event that such utility facilities are owned by a public utility, the public utility shall have the sole discretion to perform repairs or relocation work or permit the Contractor to do such repairs or relocation work at a reasonable price.

4.3.6 Conferences and Meetings. A material obligation of the Contractor under the Contract Documents is the attendance at required meetings by the Contractor's supervisory personnel for the Work and the Contractor's management personnel as required by the Contract Documents or as requested by the District. The Contractor's personnel participating in conferences and meetings relating to the Work shall be authorized to act on behalf of the Contractor and to bind the Contractor. The Contractor is solely responsible for arranging for the attendance by Subcontractors, Material Suppliers at meetings and conferences relating to the Work as necessary, appropriate or as requested by the District.

4.3.6.1 Pre-Construction Conference. The Contractor's representatives (and representatives of Subcontractors as requested by the District) shall attend a Pre-Construction Conference at such time and place as designated by the District. The Pre-Construction Conference will generally address the requirements of the Work and Contract Documents, and to establish construction procedures. Subject matters of the Pre-Construction Conference will include as appropriate: (a) administrative matters, including an overview of the respective responsibilities of the District, Architect, Construction Manager, Contractor, Subcontractor, Project Inspector and others performing any part of the Work or services relating to the Work; (b) Submittals; (c) Changes and Change Order processing; (d) employment practices, including Certified Payroll preparation and submission and prevailing wage rate responsibilities of the Contractor and Subcontractors; (e) Progress Schedule development and maintenance; (f) development of Schedule of Values and payment procedures; (g) communication procedures, including the handling of Requests for Information; (h) emergency and safety procedures; (i) Site visitor policies; (j) conduct of Contractor/Subcontractor personnel at the Site; and (k) punchlist/close-out procedures.

4.3.6.2 Progress Meetings. Progress meetings will be conducted on regular intervals

(weekly unless otherwise expressly indicated elsewhere in the Contract Documents). The Contractor's representatives and representatives of Subcontractors (as requested by the District) shall attend Progress Meetings. Progress Meetings will be chaired by the Construction Manager and will generally include as agenda items: Site safety, field issues, coordination of Work, construction progress and impacts to timely completion, if any. The purposes of the Progress Meetings include: a formal and regular forum for discussion of the status and progress of the Work by all Project participants, a review of progress or resolution of previously raised issues and action items assigned to the Project participants, and reviews of the Progress Schedule and Submittals.

4.3.6.3 Special Meetings. As deemed necessary or appropriate by the District, Special Meetings will be conducted with the participation of the Contractor, Subcontractors and other Project participants as requested by the District.

4.3.6.4 Minutes of Meetings. Following conclusion of the Pre-Construction Conference, Progress Meetings and Special Meetings, the Construction Manager or Architect will prepare and distribute minutes reflecting the items addressed and actions taken at a meeting or conference. Unless the Contractor notifies the Architect and the Construction Manager in writing of objections or corrections to minutes prepared hereunder within five (5) dates of the date of distribution of the minutes, the minutes as distributed shall constitute the official record of the meeting or conference. No objections or corrections of any Subcontractor or Material Supplier shall be submitted directly to the Architect or the Construction Manager; such objections or corrections shall be submitted to the Architect and the Construction Manager through the Contractor. If the Contractor timely interposes objections or notes corrections, the resolution of such matters shall be addressed at the next scheduled Progress Meeting.

4.3.7 Temporary Sanitary Facilities. At all times during Work at the Site, the Contractor shall obtain and maintain temporary sanitary facilities in conformity with applicable law, rule or regulation. The Contractor shall maintain temporary sanitary facilities in a neat and clean manner with sufficient toilet room supplies. Personnel engaged in the Work are not permitted to use toilet facilities at the Site.

4.3.8 Noise and Dust Control.

4.3.8.1 Noise Control. The Contractor shall install noise reducing devices on construction equipment. Contractor shall comply with the requirements of the city and county having jurisdiction with regard to noise ordinances governing construction sites and activities. Construction Equipment noise at the Site shall be limited and only as permitted by applicable law, rule or regulation. If classes are in session at any point during the progress of the Work, and, in the District's reasonable discretion, the noise from any Work disrupts or disturbs the students or faculty or the normal operation of the college, at the District's request, the Contractor shall schedule the performance of all such Work around normal college hours or make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

4.3.8.2 Dust Control. The Contractor shall be fully and solely responsible for

maintaining and upkeeping all areas of the Site and adjoining areas, outdoors and indoors, free from flying debris, grinding powder, sawdust, dirt and dust as well as any other product, product waste or work waste, that by becoming airborne may cause respiratory inconveniences to persons, particularly to students and District personnel. Additionally, the Contractor shall take specific care to avoid deposits of airborne dust or airborne elements. Such protection devices, systems or methods shall be in accordance with the regulations set forth by the EPA and OSHA, and other applicable law, rule or regulation. Additionally, the Contractor shall be the sole party responsible to regularly and routinely clean up and remove any and all deposits of dust and other elements. Damage and/or any liability derived from the Contractor's failure to comply with these requirements shall be exclusively at the cost of the Contractor, including, without limitation, any and all penalties that may be incurred for violations of applicable law, rule or regulation, and any amounts expended by the District to pay such damages shall be due and payable to the District on demand. Contractor shall replace any damages property or part thereof and professionally clean any and all items that become covered or partially covered to any degree by dust or other airborne elements. If classes are in session at any point during the progress of Work, and, in the District's reasonable discretion, flying debris, grinding powder, sawdust, dirt or dust from any Work disrupts or disturbs the students or faculty or the normal operation of the college, at the District's request, the Contractor shall schedule the performance of all such Work around normal college hours and make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

4.3.8.3 Contractor Failure to Comply. If the Contractor fails to comply with the requirements for dust control, noise control, or any other maintenance or clean up requirement of the Contract Documents, upon notice from the District, Architect, Project Inspector or Construction Manager to the Contractor, the Contractor shall take immediate action. Should the Contractor fail to respond with immediate and responsive action and not later than twenty-four (24) hours from such notification, the District shall have the absolute right to proceed as it may deem necessary to remedy such matter. Any and all costs incurred by the District in connection with such actions shall be the sole responsibility of, and be borne by, the Contractor; the District may deduct such amounts from the Contract Price then or thereafter due the Contractor.

4.3.9 Debris Recycling; Contractor Submittal of Debris Recycling Statement. The Contractor and all Subcontractors shall maintain current, complete and accurate records of debris and other waste (collectively "Waste Materials") resulting from performance of the Work. The Contractor shall compile the records of the Contractor and all Subcontractors on a monthly basis. Based on such compilation, the Contractor shall, each month during performance of the Work, complete the form of Debris Recycling Statement (Attachment C to the Special Conditions) for itself and all Subcontractors performing Work at the Site. The Debris Recycling Statement must be executed by the Contractor's Superintendent, Construction Manager or other authorized employee; the completed/executed form of Debris Recycling Statement shall be submitted by the Contractor to the District each month during the Work concurrently with the Contractor's submission of its Applications for Progress Payment. During the Contract term, monthly records for each calendar year shall be compiled by the Contractor's Superintendent and submitted to the College's Project Manager, no later than January 15th of the following year.

4.4 Labor and Materials.

4.4.1 Payment for Labor, Materials and Services. Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, Construction Equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated in the Work.

4.4.2 Employee Discipline. The Contractor shall enforce strict discipline and good order among the Contractor's employees, the employees of any Subcontractor or Sub-subcontractor, and all other persons performing any part of the Work at the Site. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them. The Contractor shall dismiss from its employ and direct any Subcontractor or Sub-subcontractor to dismiss from their employment any person deemed by the District to be unfit or incompetent to perform Work and thereafter, the Contractor shall not employ nor permit the employment of such person for performance of any part of the Work without the prior written consent of the District, which consent may be withheld in the reasonable discretion of the District.

4.4.3 Contractor's Superintendent. Contractor shall employ a competent Superintendent who is fluent in spoken and written English along with necessary assistants who shall be in attendance at the Site at all times during the performance of Work at the Site. Before commencing the Work, Contractor shall designate in writing the name, qualifications, experience and references from owners and architects on previous projects for Contractor's proposed Superintendent who, on approval of District, shall have full authority to represent and act for Contractor. All directions given to the Superintendent shall be as binding as if given to Contractor. A facsimile of the signatures of the authorized representatives of Contractor shall be submitted to Architect and District. The Contractor's communications relating to the Work or the Contract Documents shall be through the Contractor's Superintendent. The Superintendent shall represent the Contractor and communications given to the Superintendent shall be binding as if given to the Contractor. The Contractor shall dismiss the Superintendent or any of his/her assistants if they are deemed, in the sole reasonable judgment of the District, to be unfit, incompetent or incapable of performing the functions assigned to them. In such event, the District shall have the right to approve of the replacement superintendent or assistant. Unless expressly excused by the District, the Contractor's Superintendent shall attend all Project meetings as the Contractor's representative.

4.4.4 Prohibition on Harassment.

4.4.4.1 District's Policy Prohibiting Harassment. The District is committed to providing a campus and workplace free of sexual harassment and harassment based on factors such as race, color religion, national origin, ancestry, age, medical condition, marital status, disability or veteran status. Harassment includes without limitation, verbal, physical or visual conduct which creates an intimidating, offensive or hostile environment such as racial slurs; ethnic jokes; posting of offensive statements, posters or cartoons or similar conduct. Sexual harassment includes without limitation the solicitation of sexual favors, unwelcome sexual advances, or other verbal, visual or physical conduct of a sexual nature.

4.4.4.2 Contractor's Adoption of Anti-Harassment Policy. Contractor shall adopt

and implement all appropriate and necessary policies prohibiting any form of discrimination in the workplace, including without limitation harassment on the basis of any classification protected under local, state or federal law, regulation or policy. Contractor shall take all reasonable steps to prevent harassment from occurring, including without limitation affirmatively raising the subject of harassment among its employees, expressing strong disapproval of any form of harassment, developing appropriate sanctions, informing employees of their right to raise and how to raise the issue of harassment and informing complainants of the outcome of an investigation into a harassment claim. Contractor shall require that any Subcontractor or Sub-subcontractor performing any portion of the Work to adopt and implement policies in conformity with this Article 4.4.4.

4.4.4.3 Prohibition on Harassment at the Site. Contractor shall not permit any person, whether employed by Contractor, a Subcontractor, Sub-subcontractor, or any other person or entity, performing any Work at or about the Site to engage in any prohibited form of harassment. Any such person engaging in a prohibited form of harassment directed to any individual performing or providing any portion of the Work at or about the Site shall be subject to appropriate sanctions in accordance with the anti-harassment policy adopted and implemented pursuant to Article 4.4.4.2 above. Any person, performing or providing Work on or about the Site engaging in a prohibited form of harassment directed to any student, faculty member or staff of the District or directed to any other person on or about the Site shall be subject to immediate removal and shall be prohibited thereafter from providing or performing any portion of the Work. Upon the District's receipt of any notice or complaint that any person employed directly or indirectly by Contractor in performing or providing the Work has engaged in a prohibited form of harassment, the District will promptly undertake an investigation of such notice or complaint. In the event that the District, after such investigation, reasonably determines that a prohibited form of harassment has occurred, the District shall promptly notify the Contractor of the same and direct that the person engaging in such conduct be immediately removed from the Site. Unless the District's determination that a prohibited form of harassment has occurred is grossly negligent or without reasonable cause, District shall have no liability for directing the removal of any person determined to have engaged in a prohibited form of harassment nor shall the Contract Price or the Contract Time be adjusted on account thereof. Contractor and the Surety shall defend, indemnify and hold harmless the District and its employees, officers, board of trustees, agents, and representatives from any and all claims, liabilities, judgments, awards, actions or causes of actions, including without limitation, attorneys' fees, which arise out of, or pertain in any manner to: (i) the assertion by any person dismissed from performing or providing work at the direction of the District pursuant to this Article 4.4.4.3; or (ii) the assertion by any person that any person directly or indirectly under the employment or direction of the Contractor has engaged in a prohibited form of harassment directed to or affecting such person. The obligations of the Contractor and the Surety under the preceding sentence are in addition to, and not in lieu of, any other obligation of defense, indemnity and hold harmless whether arising under the Contract Documents, at law or otherwise; these obligations survive completion of the Work or the termination of the Contract.

4.5 Taxes. The Contractor shall pay, without adjustment of the Contract Price, all sales, consumer, use and other taxes for the Work or portions thereof provided by the Contractor under the Contract Documents.

4.6 Permits, Fees and Notices; Compliance With Laws.

4.6.1 Payment of Permits, Fees. The District shall secure and pay for the building permits, other permits, governmental fees, licenses and inspections necessary or required for the proper execution and completion of the Work, except as otherwise provided in the Special Conditions. If permits/approvals are designated in the Special Conditions as the Contractor's responsibility, the Contractor shall obtain such permits/approvals at its sole cost and expense without adjustment of the Contract Price. Fees, costs or other expenses associated with or arising in connection with Deferred Approval Items shall be the responsibility of the Contractor without adjustment of the Contract Price.

4.6.2 Compliance With Laws. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and other orders of public authorities bearing on performance of the Work.

4.6.3 Notice of Variation From Laws. If the Contractor knows, or has reason to believe, that any portion of the Contract Documents are at variance with applicable laws, statutes, ordinances, building codes, regulations or rules, the Contractor shall promptly notify the Architect, Construction Manager and the Project Inspector, in writing, of the same. If the Contractor performs Work knowing, or with reasonable diligence should have known, it to be contrary to laws, statutes, ordinances, building codes, rules or regulations applicable to the Work without such notice to the Architect and the Project Inspector, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs arising or associated therefrom, including without limitation, the removal, replacement or correction of the same.

4.7 Submittals.

4.7.1 Purpose of Submittals. Shop Drawings, Product Data, Samples and similar submittals (collectively "Submittals") are not Contract Documents. The purpose for submission of Submittals is to demonstrate, for those portions of the Work for which Submittals are required, the manner in which the Contractor proposes to provide or incorporate such item of the Work in conformity with the information given and the design concept expressed in the Contract Documents.

4.7.2 Contractor's Submittals.

4.7.2.1 Prompt Submittals. The Contractor shall review, approve and submit to the Architect or such other person or entity designated by the District, the number of copies of Submittals required by the Contract Documents. All Submittals required by the Contract Documents shall be prepared, assembled and submitted by the Contractor to the Architect within the time frames set forth in the Submittal Schedule incorporated and made a part of the Approved Construction Schedule prepared and submitted by the Contractor pursuant to Article 7 of these General Conditions. Contractor's submission of Submittals in conformity with the Submittal Schedule is a material obligation of the Contractor. In the event of Contractor's failure or refusal to deliver Submittals to the Architect in accordance with the Submittal Schedule, the Contractor shall be subject to per diem assessments in the amount set forth in the Special Conditions for each day of delayed submission for any Submittal beyond the date set forth in the Submittal Schedule for Contractor's submission of such Submittal. Contractor and District acknowledge and agree that if Contractor shall fail to deliver

Submittals in accordance with the Submittal Schedule, the District will incur costs and expenses not contemplated by the Contract Documents, the exact amount of which are difficult to ascertain and fix. Contractor and the District acknowledge and agree that the per diem assessment for delayed submission of Submittals set forth in the Special Conditions represents a reasonable estimate of costs and expenses the District will incur as a result of delayed submission of Submittals and that the same is not a penalty. Notwithstanding Contractor's submission of all required Submittals in accordance with the Submittal Schedule, in the event that the District or the Architect reasonably determines that all or any portion of such Submittals fail to comply with the requirements of Articles 4.7.2.2, 4.7.2.3 and 4.7.2.4 of these General Conditions and/or such Submittals are not otherwise complete and accurate so as to require re-submission, Contractor shall bear all costs associated with the review and approval of the second resubmitted Submittals, including without limitation Architect's fees incurred in connection therewith; provided that such costs are in addition to, and not in lieu of, any per diem assessments imposed under this Article 4.7.2.1 for Contractor's delayed submission of Submittals. In the event of the District's imposition of the per diem assessments due to the Contractor's delayed submission of Submittals or in the event of the District's assessment of costs and expenses incurred to review incomplete or inaccurate Submittals, the District may deduct the same from any portion the Contract Price then or thereafter due the Contractor. Submittals not required by the Contract Documents or which do not otherwise conform to the requirements of the Contract Documents may be returned without action. No adjustment to the Contract Time or the Contract Price shall be granted to the Contractor on account of its failure to make timely submission of any Submittal.

4.7.2.2 Approval of Subcontractor Submittals. All Submittals prepared by Subcontractors, of any tier, Material Suppliers, manufacturers or distributors shall bear the written approval of the Contractor thereto prior to submission to the Architect for review. Any Submittal not bearing the Contractor's written approval shall be subject to return to the Contractor for re-submittal in conformity herewith, with the same being deemed to not have been submitted. Any delay, impact or cost associated therewith shall be the sole and exclusive responsibility of the Contractor without adjustment to the Contract Time or the Contract Price.

4.7.2.3 Verification of Submittal Information. By approving and submission of Submittals, the Contractor represents to the District and Architect that the Contractor has determined and verified materials, field measurements, field construction criteria, catalog numbers and similar data related thereto and has checked and coordinated the information contained within such Submittals with the requirements of the Work and of the Contract Documents. Each Submittal shall include the following certification duly executed by the Contractor's Superintendent or Construction Manager for the Work:

"The Contractor has reviewed and approved the field dimensions and construction criteria of the attached Submittal. The Contractor has verified that the Submittal includes notations of any portion of the Work depicted in the Submittal which is not in strict conformity with the Contract Documents. The information in the attached Submittal has been reviewed and coordinated by the Contractor with information included in other Submittals."

4.7.2.4 Contractor Responsibility for Deviations. The Contractor shall not be

relieved of responsibility for correcting deviations from the requirements of the Contract Documents by the Architect's review of Submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submission of the Submittal and the Architect has given written approval to the specific deviation. A material obligation of the Contractor is its specific/detailed identification and notation on the transmittal cover-sheet of each submission of Submittals any deviation between the Work as indicated in the Contract Documents and as indicated in the Submittal. The Contractor shall not be relieved of responsibility for errors or omissions in Submittals by the Architect's review thereof.

4.7.2.5 No Performance of Work Without Architect Review. The Contractor shall perform no portion of the Work requiring the Architect's review of Submittals until the Architect has completed its review and returned the Submittal to the Contractor indicating "No Exception Taken" to such Submittal. The Contractor shall not perform any portion of the Work forming a part of a Submittal or which is affected by a related Submittal until the entirety of the Submittal or other related Submittal has been fully processed. Such Work shall be in accordance with the final action taken by the Architect in review of Submittals and other applicable portions of the Contract Documents.

4.7.3 Architect Review of Submittals. The purpose of the Architect's review of Submittals and the time for the Architect's return of Submittals to the Contractor shall be as set forth elsewhere in the Contract Documents. If the Architect returns a Submittal as rejected or requiring correction(s) with re-submission, the Contractor, so as not to delay the progress of the Work, shall promptly thereafter resubmit a Submittal conforming to the requirements of the Contract Documents; the resubmitted Submittal shall indicate the portions thereof modified in accordance with the Architect's direction. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon the accuracy and completeness of such calculations and certifications accompanying Submittals. The Architect's review of the Submittals is for the limited purposes described in the Contract Documents.

4.7.4 Deferred Approval Items. In the event that any portion of the Work is designated in the Contract Documents as a "Deferred Approval" item, Contractor shall be solely and exclusively responsible for the preparation of Submittals for such item(s) in a timely manner so as not to delay or hinder the completion of the Work within the Contract Time.

4.8 Materials and Equipment.

4.8.1 Specified Materials, Equipment. References in the Contract Documents to any specific article, device, equipment, product, material, fixture, patented process, form, method or type of construction, by name, make, trade name, or catalog number, with or without the words "or equal" shall be deemed to establish a minimum standard of quality or performance, and shall not be construed as limiting competition.

4.8.2 Approval of Substitutions or Alternatives. The Contractor may propose to furnish alternatives or substitutes for a particular item specified in the Contract Documents, provided that such proposed substitution or alternative complies with the requirements of the Specifications relating to substitutions of specified items and the Contractor certifies to the Architect that the quality, performance capability and functionality (including visual and/or aesthetic effect) of the proposed alternative or substitute will meet or exceed the

quality, performance capability and functionality of the item or process specified, and must demonstrate to the Architect that the use of the substitution or alternative is appropriate and will not delay completion of the Work or result in an increase to the Contract Price. The Contractor shall submit engineering, construction, dimension, visual, aesthetic and performance data to the Architect to permit its proper evaluation of the proposed substitution or alternative. If requested by the Architect, Contractor shall promptly furnish any additional information or data regarding a proposed substitution or alternative which the Architect deems reasonably necessary for the evaluation of the proposed substitution or alternative. The Contractor shall not provide, furnish or install any substitution or alternative without the Architect's review and final action on the proposed substitution or alternative; any alternative or substitution installed or incorporated into the Work without first obtaining the Architect's review and final action of the same shall be subject to removal pursuant to Article 12 hereof. The Architect's decision evaluating the Contractor's proposed substitutions or alternatives shall be final. Neither the Contract Time nor the Contract Price shall be increased on account of any substitution or alternative proposed by the Contractor and which is accepted by the Architect; provided, however, that in the event a substitution or alternative accepted by the Architect and purchase, fabrication and/or installation or such accepted substitution or alternative shall be less expensive than the originally specified item, the Contract Price shall be reduced by the actual cost savings realized by the Contractor's furnishing and/or installation of such approved substitution or alternative. The Contractor shall be solely responsible for all costs and fees incurred by the District to review a proposed substitution or alternative, including without limitation fees of the Architect, of the Architect's consultant(s) and/or governmental agencies to review and/or approve any proposed substitution or alternative. The Contractor shall be solely responsible for any increase in the cost of any accepted substitution or alternative or any Work affected by such alternative or substitution. The foregoing notwithstanding, all requests for the Architect's review and approval of any proposed substitution or alternative and all engineering, construction, dimension and performance data substantiating the equivalency of the proposed substitution or alternative shall be submitted by Contractor not later than thirty-five (35) days following the date of the District's award of the Contract to Contractor by action of the District's Board of Trustees; any request for approval of proposed alternatives or substitutions submitted thereafter may be rejected summarily. The foregoing process and time limits shall apply to any proposed substitution or alternative regardless of whether the substitute or alternate item is to be provided, furnished or installed by Contractor, any Subcontractor, any Sub-Subcontractor, Material Supplier or Manufacturer.

4.8.3 "Sole Source" Products. If any material, equipment, product or other item is designated in the Contract Documents as a "District Standard" or similar words/terms, the District shall be deemed to have made a finding that such material, equipment, product or other item is designated and specified to match other materials, equipment, products, or other item in use in a completed or to be completed work of improvement and not subject to substitution. If any material, equipment, or other item is identified in the Contract Documents as being the only source of the material, equipment or other item necessary to accomplish the intended result(s), such material, equipment or other item shall not be subject to substitution.

4.8.4 Placement of Material and Equipment Orders. Contractor shall, after award of the Contract, promptly and timely place all orders for materials and/or equipment necessary for completion of the Work so that delivery of the same shall be made without delay or interruption to the timely completion of the Work. Contractor shall require that any

Subcontractor or Sub-Subcontractor performing any portion of the Work similarly place orders for all materials and/or equipment to be furnished by any such Subcontractor or Sub-Subcontractor in a prompt and timely manner so that delivery of the same shall be made without delay or interruption to the timely completion of the Work. Upon request of the District, Construction Manager or the Architect, the Contractor shall furnish reasonably satisfactory written evidence of the placement of orders for materials and/or equipment necessary for completion of the Work, including without limitation, orders for materials and/or equipment to be provided, furnished or installed by any Subcontractor or Sub-Subcontractor.

4.8.5 District's Right to Place Orders for Materials and/or Equipment. Notwithstanding any other provision of the Contract Documents, in the event that the Contractor shall, upon request of the District or the Architect, fail or refuse, for any reason, to provide reasonably satisfactory written evidence of the placement of orders for materials and/or equipment necessary for completion of the Work, or should the District determine, in its sole and reasonable discretion, that any orders for materials and/or equipment have not been placed in a manner so that such materials and/or equipment will be delivered to the Site so the Work can be completed without delay or interruption, the District shall have the right, but not the obligation, to place such orders on behalf of the Contractor. If the District exercises the right to place orders for materials and/or equipment pursuant to the foregoing, the District's conduct shall not be deemed to be an exercise, by the District, of any control over the means, methods, techniques, sequences or procedures for completion of the Work, all of which remain the responsibility and obligation of the Contractor. Notwithstanding the right of the District to place orders for materials and/or equipment pursuant to the foregoing, the election of the District to exercise, or not to exercise, such right shall not relieve the Contractor from any of Contractor's obligations under the Contract Documents, including without limitation, completion of the Work within the Contract Time and for the Contract Price. If the District exercises the right hereunder to place orders for materials and/or equipment on behalf of Contractor pursuant to the foregoing, Contractor shall reimburse the District for all costs and fees incurred by the District in placing such orders; such costs and fees may be deducted by the District from the Contract Price then or thereafter due the Contractor.

4.9 Safety.

4.9.1 Safety Programs. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety programs required by applicable law, ordinance, regulation or governmental orders in connection with the performance of the Contract, or otherwise required by the type or nature of the Work. The Contractor's safety program shall include all actions and programs necessary for compliance with California or federally statutorily mandated workplace safety programs, including without limitation, compliance with the California Drug Free Workplace Act of 1990 (California Government Code §§8350 et seq.). Without limiting or relieving the Contractor of its obligations hereunder, the Contractor shall require that its Subcontractors similarly initiate and maintain all appropriate or required safety programs. Prior to commencement of Work at the Site, the Contractor shall provide the Architect, Project Inspector, the Construction Manager and District with the Contractor's proposed safety program for the Work for the Construction Manager's review. The Architect, the Construction Manager and the Project Inspector are authorized to enforce the Contractor's obligation to implement the safety program accepted by the Construction Manager.

4.9.2 Safety Precautions. The Contractor shall be solely responsible for initiating and maintaining reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to: (i) employees on the Work and other persons who may be affected thereby; (ii) the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and (iii) other property or items at the site of the Work, or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction. The Contractor shall take adequate precautions and measures to protect existing roads, sidewalks, curbs, pavement, utilities, adjoining property and improvements thereon (including without limitation, protection from settlement or loss of lateral support) and to avoid damage thereto. Without adjustment of the Contract Price or the Contract Time, the Contractor shall repair, replace or restore any damage or destruction of the foregoing items as a result of performance or installation of the Work. Contractor's personnel who do not abide by Contractor's accepted Safety Plan shall be removed from the site.

4.9.3 Safety Signs, Barricades. The Contractor shall erect and maintain, as required by existing conditions and conditions resulting from performance of the Contract, reasonable safeguards for safety and protection of property and persons, including, without limitation, posting danger signs and other warnings against hazards, promulgating safety regulations and notifying Districts and users of adjacent sites and utilities. Contractor shall provide directional and informational signage as required to direct pedestrian traffic around the work area. Contractor will be required to fence in the Construction Site and all gates shall be closed while students are on campus. Contractor shall provide spotters, both front and rear, for any vehicles moving throughout occupied student or faculty areas.

4.9.4 Safety Notices. The Contractor shall give or post all notices required by applicable law and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

4.9.5 Safety Coordinator. The Contractor shall designate a responsible member of the Contractor's organization at the Site whose duty shall be the prevention of accidents and the implementation and maintenance safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Project Inspector and the Architect.

4.9.6 Emergencies; First Aid. In an emergency affecting safety of persons or property, the Contractor shall act, to prevent threatened damage, injury or loss. The Contractor shall maintain stocked emergency first aid kits at the Site which comply with applicable law, rule or regulation.

4.9.7 Hazardous Materials.

4.9.7.1 General. In the event that the Contractor, any Subcontractor or anyone employed directly or indirectly by them shall use, at the Site, or incorporate into the Work, any material or substance deemed to be hazardous or toxic under any law, rule, ordinance, regulation or interpretation thereof (collectively "Hazardous Materials"), the Contractor shall comply with all laws, rules, ordinances or regulations applicable thereto and shall exercise all necessary safety precautions relating to the

use, storage or disposal thereof.

4.9.7.2 Prohibition on Use of Asbestos Construction Building Materials (“ACBMs”). Notwithstanding any provision of the Drawings or the Specifications to the contrary, it is the intent of the District that ACBMs not be used or incorporated into any portion of the Work. In the event that any portion of the Work depicted in the Drawings or the Specifications shall require materials or products which the Contractor knows, or should have known with reasonably diligent investigation, to contain ACBMs, Contractor shall promptly notify the Architect and the Project Inspector of the same so that an appropriate alternative can be made in a timely manner so as not to delay the progress of the Work. Contractor warrants to the District that there are no materials or products used or incorporated into the Work which contain ACBMs. Whether before or after completion of the Work, if it is discovered that any product or material forming a part of the Work or incorporated into the Work contains ACBMs, the Contractor shall at its sole cost and expense remove such product or material in accordance with any laws, rules, procedures and regulations applicable to the handling, removal and disposal of ACBMs and to replace such product or material with non-ACBM products or materials and to return the affected portion(s) of the Work to the finish condition depicted in the Drawings and Specifications relating to such portion(s) of the Work. Contractor's obligations under the preceding sentence shall survive the termination of the Contract, the warranty period provided under the Contract Documents, the Contractor's completion of the Work or the District's acceptance of the Work. In the event that the Contractor shall fail or refuse, for any reason, to commence the removal and replacement of any material or product containing ACBMs forming a part of, or incorporated into the Work, within ten (10) days of the date of the District's written notice to the Contractor of the existence of ACBM materials or products in the Work, the District may thereafter proceed to cause the removal and replacement of such materials or products in any manner which the District determines to be reasonably necessary and appropriate; all costs, expenses and fees, including without limitation fees and costs of consultants and attorneys, incurred by the District in connection with such removal and replacement shall be the responsibility of the Contractor and the Contractor's Performance Bond Surety.

4.9.7.3 Disposal of Hazardous Materials. Contractor shall be solely and exclusively responsible for the disposal of any Hazardous Materials on or about Site resulting from the Contractor's performance of Work and other activities. The Contractor's obligations hereunder shall include without limitation, the transportation and disposal of any Hazardous Materials in strict conformity with any and all applicable laws, regulations, orders, procedures or ordinances.

4.10 Maintenance of Documents.

4.10.1 Documents at Site. The Contractor shall maintain at the Site: (i) one record copy of the Drawings, Specifications and all addenda thereto; (ii) Change Orders approved by the District and all other modifications to the Contract Documents; (iii) Submittals reviewed by the Architect; (iv) Record Drawings; (v) Material Safety Data Sheets (“MSDS”) accompanying any materials, equipment or products delivered or stored at the Site or incorporated into the Work; and (vi) all building and other codes or regulations applicable to the Work, including without limitation, Title 24, Part 2 of the California Code of Regulations. During performance of the Work, all documents maintained by Contractor at

the Site shall be available to the District, the Construction Manager, the Architect, the Project Inspector and DSA for review, inspection or reproduction. Upon completion of the Work, all documents maintained at the Site by the Contractor pursuant to the foregoing shall be assembled and transmitted to the Architect for delivery to the District.

4.10.2 Maintenance of Record Drawings. During its performance of the Work, the Contractor shall maintain Record Drawings consisting of a set of the Drawings which are marked to indicate all field changes made to adapt the Work depicted in the Drawings to field conditions, changes resulting from Change Orders and all concealed or buried installations, including without limitation, piping, conduit and utility services. All buried or concealed items of Work shall be completely and accurately marked and located on the Record Drawings. The Record Drawings shall be clean and all changes, corrections and dimensions shall be marked in a neat and legible manner in a contrasting color. Record Drawings relating to the Structural, Mechanical, Electrical and Plumbing portions of the Work shall indicate without limitation, circuiting, wiring sizes, equipment/member sizing and shall depict the entirety of the as built conditions of such portions of the Work. The Record Drawings shall be continuously maintained by the Contractor during the performance of the Work. At any time during the Contractor's performance of the Work, upon the request of the District, the Project Inspector or the Architect, the Contractor shall make the Record Drawings maintained here under available for the District's review and inspection. The District's review and inspection of the Record Drawings during the Contractor's performance of the Work shall be only for the purpose of generally verifying that Contractor is continuously maintaining the Record Drawings in a complete and accurate manner; any such inspection or review shall not be deemed to be the District's approval or verification of the completeness or accuracy thereof. The failure or refusal of the Contractor to continuously maintain complete and accurate Record Drawings or to make available the Record Drawings for inspection and review by the District may be deemed by the District to be Contractor's default of a material obligation hereunder. Without waiving, restricting or limiting any other right or remedy of the District for the Contractor's failure or refusal to continuously maintain the Record Drawings, the District may, upon reasonably determining that the Contractor has not, or is not, continuously maintaining the Record Drawings in a complete and accurate manner, take appropriate action to cause the continuous maintenance of complete and accurate Record Drawings, in which event all fees and costs incurred or associated with such action shall be charged to the Contractor and the District may deduct the amount of such fees and costs from any portion of the Contract Price then or thereafter due the Contractor. In accordance with Article 8.4.2 of these General Conditions, prior to receipt of the Final Payment, Contractor shall deliver the Record Drawings to the Construction Manager for transmittal of the District.

4.11 Use of Site. The Contractor shall confine operations at the Site to areas permitted by law, ordinances or permits, subject to any restrictions or limitations set forth in the Contract Documents. The Contractor's construction site and lay down area shall be limited to the agreed upon construction site. The entire construction site shall be fenced in with temporary construction fencing until project or current phase of project is substantially complete. The fencing will be privacy screened. The Contractor shall not unreasonably encumber the Site or adjoining areas with materials or equipment. The Contractor shall be solely responsible for providing security at the Site with all such costs included in the Contract Price. The District shall at all times have access to the Site.

4.12 Clean-Up. The Contractor shall at all times keep the Site and all adjoining areas free from

the accumulation of any waste material or rubbish caused or generated by performance of the Work. Without limiting the generality of the foregoing, Contractor shall maintain the Site in a "broom-clean" standard on a daily basis. In the event that the Work of the Contract Documents includes painting and/or the installation of floor covering, prior to commencement of any painting operations or the installation of any flooring covering, the area and adjoining areas of the Site where paint is to be applied or floor covering is to be installed shall be in a "broom-clean" condition. Prior to completion of the Work, Contractor shall remove from the Site all rubbish, waste material, excess excavated material, tools, Construction Equipment, machinery, surplus material and any other items which are not the property of the District under the Contract Documents. At completion of the Work, the Contractor shall clean the building interior and exterior, including fixtures, equipment, walls, floors, ceilings, roofs, window sills and ledges, horizontal surfaces, areas where debris, dust and similar items have collected, clean and polish all glass, plumbing fixtures, finish hardware, metal/wood/stone finishes. As directed by the Construction Manager, District or Architect, the Contractor shall remove temporary fencing, barricades, planking, temporary sanitary facilities, temporary utility distributions and other temporary facilities. Upon completion of the Work, the Site and all adjoining areas shall be left in a neat and broom clean condition satisfactory to District. The Project Inspector or Construction Manager shall be authorized to direct the Contractor's clean-up obligations hereunder. If the Contractor fails to clean up as provided for in the Contract Documents, the District may do so, and all costs incurred in connection therewith shall be charged to the Contractor; the District may deduct such costs from any portion of the Contract Price then or thereafter due the Contractor.

- 4.13 Access to the Work.** The Contractor shall provide the DSA, the District, the Construction Manager, the Project Inspector, the Architect and the Architect's consultant(s) with access to the Work, whether in place, preparation and progress and wherever located.
- 4.14 Information and Facilities/Services for the Project Inspector.** The Contractor shall furnish the Project Inspector access to the Work for obtaining such information as may be necessary to keep the Project Inspector fully informed respecting the progress, quality and character of the Work and materials, equipment or other items incorporated therein. The Contractor shall provide, without adjustment of the Contract Price, for use by the Project Inspector, the District and Construction Manager the facilities, equipment, furnishings and services set forth in the Special Conditions. If the Contractor does not provide the facilities, furnishings, equipment and services set forth in the Special Conditions, or fails to pay timely any charges or fees arising out of the use of the same, the District may, as applicable, procure facilities, furnishings, equipment and services required by the Contract Documents or pay outstanding charges. Contractor shall reimburse the District for all costs, including the District's administrative costs, incurred by the District pursuant to the preceding sentence; in lieu of the Contractor's reimbursement and at the sole and exclusive discretion of the District, such costs may be deducted by the District from any portion of the Contract Price or thereafter due the Contractor.
- 4.15 Patents and Royalties.** The Contractor and the Surety shall defend, indemnify and hold harmless the District and its agents, employees and officers from any claim, demand or legal proceeding arising out of or pertaining, in any manner, to any actual or claimed infringement of patent rights in connection with performance of the Work under the Contract Documents.
- 4.16 Cutting and Patching.** The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make the component parts thereof fit together properly. The Contractor shall not damage or endanger any portion of the Work, or the fully or partially

completed construction of the District or separate contractors by cutting, patching, excavation or other alteration. When modifying new Work or when installing Work adjacent to an existing structure/facility, the Contractor shall match, as closely as conditions of the Site and materials will allow the finishes, textures and colors of the existing structure/facility and refinish elements of the existing structure/facility. The Contractor shall not cut, patch or otherwise alter the construction by the District or separate contractor without the prior written consent of the District or separate contractor thereto, which consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold consent to the request of the District or separate contractor to cut, patch or otherwise alter the Work.

4.17 Encountering of Hazardous Materials. In the event the Contractor encounters Hazardous Materials at the Site which have not been rendered harmless or for which there is no provision in the Contract Documents for containment, removal, abatement or handling of such Hazardous Materials, the Contractor shall immediately stop the Work in the affected area, but shall diligently proceed with the Work in all other unaffected areas. Upon encountering such Hazardous Materials, the Contractor shall immediately notify the Project Inspector and the Architect, in writing, of such condition. The Contractor shall proceed with the Work in such affected area only after such Hazardous Materials have been rendered harmless, contained, removed or abated. In the event such Hazardous Materials are encountered, the Contractor shall be entitled to an adjustment of the Contract Time to the extent that the Work is stopped and Substantial Completion of the Work is affected thereby. In no event shall there be an adjustment to the Contract Price solely on account of the Contractor encountering such Hazardous Materials.

4.18 Wage Rates; Employment of Labor.

4.18.1 Determination of Prevailing Rates. Pursuant to the provisions of Division 2, Part 7, Chapter 1, Article 2 of the California Labor Code at §§1770 et seq., the District has obtained from the Director of the Department of Industrial Relations the general prevailing rate of per diem wages and the prevailing rate for holiday and overtime work in the locality in which the Work is to be performed. Holidays shall be as defined in the collective bargaining agreement applicable to each particular craft, classification or type of worker employed under the Contract. Per diem wages include employer payments for health and welfare, pensions, vacation, travel time and subsistence pay as provided in California Labor Code §1773.8, apprenticeship or other training programs authorized by California Labor Code §3093, and similar purposes when the term “per diem wages” is used herein. Holiday and overtime work, when permitted by law, shall be paid for at the rate of at least one and one-half (1½) times the above specified rate of per diem wages, unless otherwise specified. The Contractor shall post, at appropriate and conspicuous locations on the Site, a schedule showing all determined general prevailing wage rates.

4.18.2 Payment of Prevailing Rates. There shall be paid each worker of the Contractor, or any Subcontractor, of any tier, engaged in the Work, not less than the general prevailing wage rate, regardless of any contractual relationship which may be alleged to exist between the Contractor or any Subcontractor, of any tier, and such worker.

4.18.3 Prevailing Rate Penalty. The Contractor shall, as a penalty, forfeit not more than Fifty Dollars (\$50.00) to the District for each calendar day or portion thereof, for each worker paid less than the prevailing rates for such work or craft in which such worker is employed for the Work by the Contractor or by any Subcontractor, of any tier, in connection with the Work. The amount of the penalty for failure to pay applicable prevailing wage rates shall

be determined and assessed in accordance with the standards established pursuant to Labor Code §1775(a)(2). The amount of the penalty shall be determined based on consideration of both of the following: (i) whether the failure of the Contractor or Subcontractor to pay the correct rate of per diem wages was a good faith mistake and, if so, the error was promptly and voluntarily corrected when brought to the attention of the Contractor or Subcontractor; and (ii) whether the Contractor or Subcontractor has a prior record of failing to meet its prevailing wage obligations. The penalty may not be less than ten dollars (\$10) for each calendar day, or portion thereof, for each worker paid less than the prevailing wage rate, unless the failure of the Contractor or Subcontractor to pay the correct rate of per diem wages was a good faith mistake and, if so, the error was promptly and voluntarily corrected when brought to the attention of the contractor or subcontractor. The penalty may not be less than twenty dollars (\$20) for each calendar day, or portion thereof, for each worker paid less than the prevailing wage rate, if the Contractor or Subcontractor has been assessed penalties within the previous three years for failing to meet its prevailing wage obligations on a separate contract, unless those penalties were subsequently withdrawn or overturned. The penalty may not be less than thirty dollars (\$30) for each calendar day, or portion thereof, for each worker paid less than the prevailing wage rate, if the Labor Commissioner determines that the violation was willful, as defined in subdivision (c) of Section 1777.1. When the penalty amount due hereunder is collected from the Contractor or Subcontractor, any outstanding wage claim under Chapter 1 (commencing with Section 1720) of Part 7 of Division 2 against that Contractor or Subcontractor shall be satisfied before applying that amount to the penalty imposed on that Contractor or Subcontractor hereunder. The difference between prevailing wage rates and the amount paid to each worker each calendar day, or portion thereof, for which each worker paid less than the prevailing wage rate, shall be paid to each worker by the Contractor.

4.18.4 Payroll Records. Pursuant to California Labor Code §1776, the Contractor and each Subcontractor, of any tier, shall keep an accurate payroll record, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each person employed for the Work. The payroll records shall be certified and available for inspection at all reasonable hours at the principal office of the Contractor on the following basis: (i) a certified copy of an employee's payroll record shall be made available for inspection or furnished to such employee or his/her authorized representative on request; (ii) a certified copy of all payroll records shall be made available for inspection or furnished upon request to the District, the Division of Labor Standards Enforcement and the Division of Apprenticeship Standards of the Department of Industrial Relations; (iii) a certified copy of payroll records shall be made available upon request to the public for inspection or copies thereof made; provided, however, that a request by the public shall be made through either the District, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement. If the requested payroll records have not been provided, the requesting party shall, prior to being provided the records, reimburse the cost of preparation by the Contractor, Subcontractors and the entity through which the request was made; the public shall not be given access to such records at the principal office of the Contractor; (iv) the Contractor shall file a certified copy of the payroll records with the entity that requested such records within ten (10) days after receipt of a written request; (v) any copy of records made available for inspection as copies and furnished upon request to the public or any public agency by the District, the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address and social security number. The name

and address of the Contractor or any Subcontractor, of any tier, performing a part of the Work shall not be marked or obliterated. The Contractor shall inform the District of the location of payroll records, including the street address, city and county and shall, within five (5) working days, provide a notice of a change or location and address. In the event of noncompliance with the requirements of this Article 4.18.4, the Contractor shall have ten (10) days in which to comply, subsequent to receipt of written notice specifying in what respects the Contractor must comply herewith. Should noncompliance still be evident after such 10-day period, the Contractor shall, as a penalty to the District, forfeit Twenty-Five Dollars (\$25.00) for each calendar day, or portion thereof, for each worker, until strict compliance is effectuated. Upon the request of the Division of Apprenticeship Standards or the Division of Labor Standards Enforcement, such penalties shall be withheld from any portion of the Contract Price then or thereafter due the Contractor. The Contractor is solely responsible for compliance with the foregoing provisions.

4.18.5 Hours of Work.

4.18.5.1 Limits on Hours of Work. Pursuant to California Labor Code §1810, eight (8) hours of labor shall constitute a legal day's work. Pursuant to California Labor Code §1811, the time of service of any worker employed at any time by the Contractor or by a Subcontractor, of any tier, upon the Work or upon any part of the Work, is limited and restricted to eight (8) hours during any one calendar day and forty (40) hours during any one calendar week, except as hereafter provided. Notwithstanding the foregoing provisions, Work performed by employees of Contractor or any Subcontractor, of any tier, in excess of eight (8) hours per day and forty (40) hours during any one week, shall be permitted upon compensation for all hours worked in excess of eight (8) hours per day at not less than one and one-half (1½) times the basic rate of pay.

4.18.5.2 Penalty for Excess Hours. The Contractor shall pay to the District a penalty of Twenty-five Dollars (\$25.00) for each worker employed on the Work by the Contractor or any Subcontractor, of any tier, for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any calendar day and forty (40) hours in any one calendar week, in violation of the provisions of the California Labor Code, unless compensation to the worker so employed by the Contractor is not less than one and one-half (1½) times the basic rate of pay for all hours worked in excess of eight (8) hours per day.

4.18.5.3 Contractor Responsibility. Any Work performed by workers necessary to be performed after regular working hours or on Sundays or other holidays shall be performed without adjustment to the Contract Price or any other additional expense to the District. The Contractor shall be responsible for costs incurred by the District which arise out of Work performed by the Contractor at times other than regular working hours and regular working days. Upon determination of such costs, the District may deduct such costs from the Contract Price then or thereafter due the Contractor.

4.18.6 Apprentices.

4.18.6.1 Employment of Apprentices. Any apprentices employed to perform any of the Work shall be paid the standard wage paid to apprentices under the regulations of the craft or trade for which such apprentice is employed, and such individual shall

be employed only for the work of the craft or trade to which such individual is registered. Only apprentices, as defined in California Labor Code §3077 who are in training under apprenticeship standards and written apprenticeship agreements under California Labor Code §§3070 et seq. are eligible to be employed for the Work. The employment and training of each apprentice shall be in accordance with the provisions of the apprenticeship standards and apprentice agreements under which such apprentice is training.

4.18.6.2 Apprenticeship Certificate. When the Contractor or any Subcontractor, of any tier, in performing any of the Work employs workers in any Apprenticeable Craft or Trade, the Contractor and such Subcontractor shall apply to the Joint Apprenticeship Committee administering the apprenticeship standards of the craft or trade in the area of the site of the Work for a certificate approving the Contractor or such Subcontractor under the apprenticeship standards for the employment and training of apprentices in the area or industry affected, provided, however, that the approval as established by the Joint Apprenticeship Committee or Committees shall be subject to the approval of the Administrator of Apprenticeship. The Joint Apprenticeship Committee or Committees, subsequent to approving the Contractor or Subcontractor, shall arrange for the dispatch of apprentices to the Contractor or such Subcontractor in order to comply with California Labor Code §1777.5. The Contractor and Subcontractors shall submit contract award information to the applicable Joint Apprenticeship Committee which shall include an estimate of journeyman hours to be performed under the Contract, the number of apprentices to be employed, and the approximate dates the apprentices will be employed. There shall be an affirmative duty upon the Joint Apprenticeship Committee or Committees, administering the apprenticeship standards of the crafts or trades in the area of the site of the Work, to ensure equal employment and affirmative action and apprenticeship for women and minorities. Contractors or Subcontractors shall not be required to submit individual applications for approval to local Joint Apprenticeship Committees provided they are already covered by the local apprenticeship standards.

4.18.6.3 Ratio of Apprentices to Journeymen. The ratio of Work performed by apprentices to journeymen, who shall be employed in the Work, may be the ratio stipulated in the apprenticeship standards under which the Joint Apprenticeship Committee operates, but in no case shall the ratio be less than one hour of apprentice work for each five hours of labor performed by a journeyman, except as otherwise provided in California Labor Code §1777.5. The minimum ratio for the land surveyor classification shall not be less than one apprentice for each five journeymen. Any ratio shall apply during any day or portion of a day when any journeyman, or the higher standard stipulated by the Joint Apprenticeship Committee, is employed at the site of the Work and shall be computed on the basis of the hours worked during the day by journeymen so employed, except for the land surveyor classification. The Contractor shall employ apprentices for the number of hours computed as above before the completion of the Work. The Contractor shall, however, endeavor, to the greatest extent possible, to employ apprentices during the same time period that the journeymen in the same craft or trade are employed at the site of the Work. Where an hourly apprenticeship ratio is not feasible for a particular craft or trade, the Division of Apprenticeship Standards, upon application of a Joint Apprenticeship Committee, may order a minimum ratio of not less than one apprentice for each five journeymen in a craft or trade classification. The Contractor or any Subcontractor covered by this Article and California Labor Code §1777.5, upon the issuance of the approval

certificate, or if it has been previously approved in such craft or trade, shall employ the number of apprentices or the ratio of apprentices to journeymen stipulated in the apprenticeship standards. Upon proper showing by the Contractor that it employs apprentices in such craft or trade in the State of California on all of its contracts on an annual average of not less than one apprentice to each five journeymen, the Division of Apprenticeship Standards may grant a certificate exempting the Contractor from the 1-to-5 ratio as set forth in this Article and California Labor Code §1777.5. This Article shall not apply to contracts of general contractors, or to contracts of specialty contractors not bidding for work through a general or prime contractor, involving less than Thirty Thousand Dollars (\$30,000.00) or twenty (20) working days. The term "Apprenticeable Craft or Trade," as used herein shall mean a craft or trade determined as an Apprenticeable occupation in accordance with rules and regulations prescribed by the Apprenticeship Council.

4.18.6.4 Exemption From Ratios. The Joint Apprenticeship Committee shall have the discretion to grant a certificate, which shall be subject to the approval of the Administrator of Apprenticeship, exempting the Contractor from the 1-to-5 ratio set forth in this Article when it finds that any one of the following conditions are met: (i) unemployment for the previous three-month period in such area exceeds an average of fifteen percent (15%) or; (ii) the number of apprentices in training in such area exceeds a ratio of 1-to-5 in relation to journeymen, or; (iii) the Apprenticeable Craft or Trade is replacing at least one-thirtieth (1/30) of its journeymen annually through apprenticeship training, either on a statewide basis or on a local basis, or; (iv) if assignment of an apprentice to any Work performed under the Contract Documents would create a condition which would jeopardize such apprentice's life or the life, safety or property of fellow employees or the public at large, or if the specific task to which the apprentice is to be assigned is of such a nature that training cannot be provided by a journeyman. When such exemptions from the 1-to-5 ratio between apprentices and journeymen are granted to an organization which represents contractors in a specific trade on a local or statewide basis, the member contractors will not be required to submit individual applications for approval to local Joint Apprenticeship Committees, provided they are already covered by the local apprenticeship standards.

4.18.6.5 Contributions to Trust Funds. The Contractor or any Subcontractor, of any tier, who, performs any of the Work by employment of journeymen or apprentices in any Apprenticeable Craft or Trade and who is not contributing to a fund or funds to administer and conduct the apprenticeship program in any such craft or trade in the area of the site of the Work, to which fund or funds other contractors in the area of the site of the Work are contributing, shall contribute to the fund or funds in each craft or trade in which it employs journeymen or apprentices in the same amount or upon the same basis and in the same manner as the other contractors do, but where the trust fund administrators are unable to accept such funds, contractors not signatory to the trust agreement shall pay a like amount to the California Apprenticeship Council. The Division of Labor Standards Enforcement is authorized to enforce the payment of such contributions to such fund(s) as set forth in California Labor Code §227. Such contributions shall not result in an increase in the Contract Price.

4.18.6.6 Contractor's Compliance. The responsibility of compliance with this Article for all Apprenticeable Trades or Crafts is solely and exclusively that of the Contractor. All decisions of the Joint Apprenticeship Committee(s) under this Article are subject

to the provisions of California Labor Code §3081. In the event the Contractor willfully fails to comply with the provisions of this Article and California Labor Code §1777.5, pursuant to California Labor Code §1777.7, the Contractor shall: (i) be denied the right to bid on any public works contract for a period of one (1) year from the date the determination of non-compliance is made by the Administrator of Apprenticeship; and (ii) forfeit, as a civil penalty, Fifty Dollars (\$50.00) for each calendar day of noncompliance. Notwithstanding the provisions of California Labor Code §1727, upon receipt of such determination, the District shall withhold such amount from the Contract Price then due or to become due. Any such determination shall be issued after a full investigation, a fair and impartial hearing, and reasonable notice thereof in accordance with reasonable rules and procedures prescribed by the California Apprenticeship Council. Any funds withheld by the District pursuant to this Article shall be deposited in the General Fund or other similar fund of the District. The interpretation and enforcement of California Labor Code §§1777.5 and 1777.7 shall be in accordance with the rules and procedures of the California Apprenticeship Council.

4.18.7 Employment of Independent Contractors. Pursuant to California Labor Code §1021.5, Contractor shall not willingly and knowingly enter into any agreement with any person, as an independent contractor, to provide any services in connection with the Work where the services provided or to be provided requires that such person hold a valid contractors license issued pursuant to California Business and Professions Code §§7000 et seq. and such person does not meet the burden of proof of his/her independent contractor status pursuant to California Labor Code §2750.5. In the event that Contractor shall employ any person in violation of the foregoing, Contractor shall be subject to the civil penalties under California Labor Code §1021.5 and any other penalty provided by law. In addition to the penalties provided under California Labor Code §1021.5, Contractor's violation of this Article 4.18.7 or the provisions of California Labor Code §1021.5 shall be deemed an event of Contractor's default under Article 15.1 of these General Conditions. The Contractor shall require any Subcontractor or Sub-Subcontractor performing or providing any portion of the Work to adhere to and comply with the foregoing provisions.

4.19 Assignment of Antitrust Claims. Pursuant to California Government Code §4551, the Contractor and its Subcontractor(s), of any tier, hereby offers and agrees to assign to the District all rights, title and interest in and to all causes of action they may have under Section 4 of the Clayton Act, (15 U.S.C. §15) or under the Cartwright Act (California Business and Professions Code §§16700 et seq.), arising from purchases of goods, services or materials hereunder or any Subcontract. This assignment shall be made and become effective at the time the District tenders Final Payment to the Contractor, without further acknowledgment by the parties. If the District receives, either through judgment or settlement, a monetary recovery in connection with a cause of action assigned under California Government Code §§4550 et seq., the assignor thereof shall be entitled to receive reimbursement for actual legal costs incurred and may, upon demand, recover from the District any portion of the recovery, including treble damages, attributable to overcharges that were paid by the assignor but were not paid by the District as part of the Contract Price, less the expenses incurred by the District in obtaining that portion of the recovery. Upon demand in writing by the assignor, the District shall, within one year from such demand, reassign the cause of action assigned pursuant to this Article if the assignor has been or may have been injured by the violation of law for which the cause of action arose: and (i) the District has not been injured thereby; or (ii) the District declines to file a court action for the cause of action.

4.20 Limitations Upon Site Activities. Except in the circumstances of an emergency, no construction activities shall be permitted at or about the Site except during the District's hours and days set forth in the Special Conditions. Work performed outside of the hours and days noted in the Special Conditions will not result in adjustment of the Contract Time or the Contract Price; unless Work outside of the hours and days noted in the Special Conditions is expressly authorized by the District.

4.21 Labor Compliance Program ("LCP"). Pursuant to Labor Code §1771.7, the District has established a Labor Compliance Program. Unless otherwise expressly provided in the Contract Documents, the LCP is applicable to the entirety of the Work. A material obligation of the Contractor awarded the Contract is its strict compliance with all applicable provisions and requirements of the LCP and its strict enforcement of such provisions and requirements on its Subcontractors and others under the direction or control of the Contractor relating to the Work or the Project. A copy of the LCP is available for review and reproduction in the District's administrative office.

4.21.1 Pre-Construction Conference. In addition to the matters included in the scope of the Pre-Conference, as set forth in Article 4.3.6.1 of the General Conditions, the Pre-Construction conference will include a discussion of the subject matters indicated in the Pre-Construction Conference portion of the LCP, including general requirements of the LCP, measures for compliance with, and enforcement of, LCP requirements, and penalties for failure to comply. The Contractor awarded the Contract and each Subcontractor identified by such Contractor in its Subcontractors List submitted with its Bid Proposal. The foregoing notwithstanding, if the District reasonably determines that individuals or entities in addition to the Contractor and its listed Subcontractor are necessary attendees at the Pre-Construction conference, the Contractor is responsible for measures necessary to secure the attendance of such other persons or entities at the Pre-Construction conference.

4.21.2 Maintenance and Weekly Submission of Certified Payroll Records. The Contractor and each of its Subcontractors shall maintain accurate, complete and current payroll records as required by the LCP. During the progress of the Work, until Final Payment is due, the Contractor and its Subcontractors shall maintain and submit Certified Payroll Records on a weekly basis. No later than the 5:00 P.M. on each Monday during the Work, the Contractor shall submit to the Construction Manager Certified Payroll Records for the Contractor and its Subcontractors for all persons providing or performing any Work in the immediately preceding week. The Certified Payroll Records maintained and submitted hereunder shall be in strict conformity with requirements established in the LCP. A material obligation of the Contractor under the Contract Documents is the Contractor's and its Subcontractor's strict compliance with requirements of the LCP relating to maintenance and submission of Certified Payroll Records. The Contractor's submittal of weekly Certified Payroll Records in strict conformity with requirements of the LCP is an express condition precedent to the District's obligation to disburse any Progress Payment to the Contractor and the Contractor's entitlement to receipt of any Progress Payment.

4.21.3 District Audit of Certified Payroll Records. Pursuant to the LCP, the District shall, as appropriate or necessary conduct audits of Certified Payroll Records. If upon conducting such audits, the District determines that the Contractor or its Subcontractors have committed violations of the LCP, the Contractor and/or its Subcontractors shall be subject to all penalties, assessments and other remedies set forth in the LCP or by

operation of law for such violations.

4.21.4 Contractor's Rights Upon Determination of Violation. If upon audit of Certified Payroll Records, the District determines that the Contractor has violated, or failed to comply with, applicable provisions of the LCP, the Contractor shall be subject to the penalties, assessments and other remedies set forth in the LCP for the Contractor's violation of, or failure to comply with, the LCP. To the extent applicable, the Contractor shall be entitled to contest or appeal such determination, as set forth in the LCP, provided that the Contractor strictly complies with all applicable provisions of applicable law and the LCP relating to the initiation and completion of proceeding to contest or appeal a determination that the Contractor has committed a violation of, or failed to comply with, the LCP.

4.21.5 LCP Not Exclusive. The LCP is not the exclusive source of Contractor's obligations relating to the payment of prevailing wages and compliance with apprenticeship standards. A material obligation of the Contractor under the Contract Documents is the Contractor's compliance with all applicable laws, codes, regulations, rules and orders relating to the employment of labor, working conditions, and payments to laborers for Work performed or provided by laborers.

4.22 State Audit. Pursuant to and in accordance with the provisions of Government Code §8546.7, or any amendments thereto, all books, records and files of the District, the Contractor, or any Subcontractor relating to the Work or the performance of work involving the expenditure of public funds in excess of Ten Thousand Dollars (\$10,000), including, but not limited to, the administration thereof, shall be subject to the examination and audit by the State Auditor of the State of California, at the request of District or as part of any audit of District, for a period of three (3) years after Final Payment is made under this Contract. Contractor shall preserve and cause to be preserved such books, records and files for the audit period. Upon request of the District, the Contractor shall make all such books, records or files available for review, inspection and/or reproduction.

ARTICLE 5: SUBCONTRACTORS

5.1 Subcontracts. Any Work performed for the Contractor by a Subcontractor shall be pursuant to a written agreement between the Contractor and such Subcontractor which specifically incorporates by reference the Contract Documents and which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents, including without limitation, the policies of insurance required under Article 6 of these General Conditions and the termination provisions of Article 15, and obligates the Subcontractor to assume toward the Contractor all the obligations and responsibilities of the Contractor which by the Contract Documents the Contractor assumes toward the District, the Project Inspector, DSA, the Construction Manager and the Architect. The foregoing notwithstanding, no contractual relationship shall exist, or be deemed to exist, between any Subcontractor and the District, unless the Contract is terminated and District, in writing, elects to assume the Subcontract. Each Subcontract for a portion of the Work shall provide that such Subcontract may be assigned to the District if the Contract is terminated by the District pursuant to Article 15.1 hereof, subject to the prior rights of the Surety obligated under a bond relating to the Contract. The Contractor shall provide to the District copies of all executed Subcontracts and Purchase Orders to which Contractor is a party within thirty (30) days after Contractor's execution of the Agreement. During performance of the Work, the Contractor shall, from time to time, as and when requested by the District, the Architect or the Construction Manager provide the District with copies of any and all Subcontracts or Purchase Orders relating to

the Work and all modifications thereto. The Contractor's failure or refusal, for any reason, to provide copies of such Subcontracts or Purchase Orders in accordance with the two preceding sentences is Contractor's default of a material term of the Contract Documents.

5.2 Substitution of Listed Subcontractor.

5.2.1 Substitution Process. Any request of the Contractor to substitute a listed Subcontractor will be considered only if such request is in strict conformity with this Article 5.2 and California Public Contract Code §4107. All costs incurred by the District, including without limitation, costs of the Project Inspector, the Architect, the Construction Manager or attorneys fees in the review and evaluation of a request to substitute a listed Subcontractor shall be borne by the Contractor; such costs may be deducted by the District from the Contract Price then or thereafter due the Contractor.

5.2.2 Responsibilities of Contractor Upon Substitution of Subcontractor. The District's consent to Contractor's substitution of a listed Subcontractor shall not relieve Contractor from its obligation to complete the Work within the Contract Time and for the Contract Price. The substitution of a listed Subcontractor shall not, under any circumstance, result in, or give rise to any to any increase of the Contract Price or the Contract Time on account of such substitution. In the event of the District's consent to the substitution of a listed Subcontractor, the Architect shall determine the extent to which, if any, revised or additional Submittals will be required of the newly substituted Subcontractor. In the event that the Architect determines that revised or additional Submittals are required of the newly substituted Subcontractor, the Architect shall promptly notify the Contractor, in writing, of such requirement. In such event, revised or additional Submittals shall be submitted to Architect not later than thirty (30) days following the date of the Architect's written notice to the Contractor pursuant to the foregoing sentence; provided that if in the reasonable and good faith judgment of the Architect, the progress of the Work or completion of the Work requires submission of additional or revised Submittals by the newly substituted Subcontractor in less than thirty (30) days, the Architect shall so state in its written notice to the Contractor. In the event that the revised or additional Submittals are not submitted by Contractor within thirty (30) days, or such earlier time as determined by the Architect pursuant to the preceding sentence, following the Architect's written notice of the requirement for revised or additional Submittals, Contractor shall be subject to the per diem assessments for late Submittals as set forth in Article 4.7.2.1 of these General Conditions. Any revised or additional Submittals required pursuant to this Article 5.2.2 shall conform to the requirements of Article 4.7 of these General Conditions. Contractor shall reimburse the District for all fees and costs, including without limitation fees of the Construction Manager, Architect and/or any design consultant to the Architect or the District and DSA fees, incurred or associated with the processing, review and evaluation of any revised or additional Submittals required pursuant to this Article 5.2.2; the District may deduct such fees and costs from any portion of the Contract Price then or thereafter due the Contractor. In the event that additional or revised Submittals are required pursuant to this Article 5.2.2, such requirement shall not result in an increase to the Contract Time or the Contract Price.

5.3 Subcontractors' Work. Whenever the Work of a Subcontractor is dependent upon the Work of the Contractor or another Subcontractor, the Contractor shall require the Subcontractor to: (a) coordinate its Work with the dependent Work; (b) provide necessary dependent data and requirements; (c) supply and/or install items to built into the dependent Work of others; (d) make appropriate provisions for dependent Work of others; (e) carefully examine and understand the portions of the Contract Documents (including Drawings, Specifications and

Field Clarifications) and Submittals relating to the dependent Work; and (f) examine the existing dependent Work and verify that the dependent Work is in proper condition for the Subcontractor's Work. If the dependent Work is not in a proper condition, the Subcontractor shall notify the Contractor in writing and not proceed with the Subcontractor's Work until the dependent Work has been corrected or replaced and is in a proper condition for the Subcontractor's Work.

- 5.4 Subcontractors' Compliance With LCP.** As applicable, each Subcontractor performing Work shall comply with the LCP. A material obligation of the Contractor is its enforcement of Subcontractor obligations relating to the LCP; failure of the Contractor to strictly enforce such Subcontractor obligations is a material obligation of the Contractor under the Contract Documents.

ARTICLE 6: INSURANCE; INDEMNITY; BONDS

- 6.1 Workers' Compensation Insurance; Employer's Liability Insurance.** The Contractor shall purchase and maintain Workers' Compensation Insurance as will protect the Contractor from claims under workers' or workmen's compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. Contractor shall purchase and maintain Employer's Liability Insurance covering bodily injury (including death) by accident or disease to any employee which arises out of the employee's employment by Contractor. The Employer's Liability Insurance required of Contractor hereunder may be obtained by Contractor as a separate policy of insurance or as an additional coverage under the Workers' Compensation Insurance required to be obtained and maintained by Contractor hereunder. The limits of liability for the Employer's Liability Insurance required hereunder shall be as set forth in the Special Conditions.
- 6.2 Commercial General Liability and Property Insurance.** The Contractor shall purchase and maintain Commercial General Liability and Property Insurance covering the types of claims set forth below which may arise out of or result from Contractor's operations under the Contract Documents and for which the Contractor may be legally responsible: (i) claims for damages because of bodily injury, sickness or disease or death of any person other than the Contractor's employees; (ii) claims for damages insured by usual personal injury liability coverage which are sustained (a) by a person as a result of an offense directly or indirectly related to employment of such person by the Contractor, or (b) by another person; (iii) claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom; (iv) claims for damages because of bodily injury, death of a person or property damages arising out of ownership, maintenance or use of a motor vehicle; (v) contractual liability insurance applicable to the Contractor's obligations under the Contract Documents; and (vi) Completed Operations.
- 6.3 Builder's Risk "All-Risk" Insurance.** The Contractor shall obtain Builders Risk insurance covering the full insurable value of the Work from risks of loss, damage or destruction of Work in progress or in place at the Site prior to Final Acceptance including without limitation coverage for losses resulting from the perils of fire, malicious mischief, vandalism, and collapse. The Builder's Risk Insurance Policy shall include coverage for seismic risks if so indicated in the Special Conditions.
- 6.4 Insurance Policy Requirements.** Each policy of insurance required by the Contract

Documents shall confirm the following requirements.

6.4.1 Minimum Coverage Amounts. The insurance required of the Contractor hereunder shall be written for not less than any limits of liability specified in the Contract Documents, or required by law, whichever is greater. In the event of any loss or damage covered by a policy of insurance required to be obtained and maintained by the Contractor hereunder, the Contractor shall be solely and exclusively responsible for the payment of the deductible, if any, under such policy of insurance, without adjustment to the Contract Price on account thereof.

6.4.2 Required Qualifications of Insurers. The Contractor and Subcontractors' policies of Commercial General Liability and Property/Casualty insurance and the Contractor's Builders Risk insurance will be accepted by the District only if the insurer(s) are: (a) A.M. Best rated A- or better; (b) A.M. Best Financial Size Category VII or higher; and (c) authorized under California law to transact business in the State of California and authorized to issue insurance policies in the State of California. If at any time during performance of the Work, the insurer(s) issuing a policy of insurance covering Commercial General Liability, Property/Casualty or Builder Risk is/are not A.M. Best rated A- or better and is/are not A.M. Best Financial Size Category VII or higher, the Contractor or Subcontractor, as applicable shall within thirty (30) days of the District's written notice of the insufficiency of an insurer to the Contractor, obtain insurance coverage(s) from alternative insurer(s) who is/are then A.M. Best rated A- or better and who is/are A.M. Best Financial Size Category VII or higher. If the Contractor fails to deliver Certificate(s) of Insurance from an alternative insurer(s) meeting or exceeding the A.M. Best rating and A.M. Best Financial Size Category set forth above, within thirty (30) days of the date of the District's issuance of a written notice pursuant to the preceding sentence, in addition to any other right or remedy of the District under the Contract Documents or arising by operation of law, the District may withhold disbursement of any Progress Payment otherwise due hereunder until the Contractor has delivered such Certificate(s) of Insurance from an alternative insurer(s).

6.5 Evidence of Insurance; Subcontractor's Insurance.

6.5.1 Certificates of Insurance. Prior to commencing the Work, Contractor shall deliver to the District Certificates of Insurance evidencing the insurance coverages required by the Contract Documents. Failure or refusal of the Contractor to so deliver Certificates of Insurance may be deemed by the District to be a default of a material obligation of the Contractor under the Contract Documents, and thereupon the District may proceed to exercise any right or remedy provided for under the Contract Documents or at law. The Certificates of Insurance and the insurance policies required by the Contract Documents shall contain a provision that coverages afforded under such policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the District. The insurance policies required of Contractor hereunder shall also name the District, the Architect and the Construction Manager as additional insureds as their interests may appear. Should any policy of insurance be canceled before Final Acceptance of the Work by the District and the Contractor fails to immediately procure replacement insurance as required, the District reserves the right to procure such insurance and to deduct the premium cost thereof and other costs incurred by the District in connection therewith from any sum then or thereafter due the Contractor under the Contract Documents. The Contractor shall, from time to time, furnish the District, when requested, with satisfactory proof of coverage of each type of insurance required by the Contract

Documents; failure of the Contractor to comply with the District's request may be deemed by the District to be a default of a material obligation of the Contractor under the Contract Documents.

- 6.5.2 Subcontractors' Insurance.** Contractor shall require that every Subcontractor, of any tier, performing or providing any portion of the Work obtain and maintain the policies of insurance set forth in Articles 6.1 and 6.2 of these General Conditions; the coverages and limits of liability of such policies of insurance to be obtained and maintained by Subcontractors shall be as set forth in the Special Conditions. The policies of insurance to be obtained and maintained by Subcontractors hereunder are in addition to, and not in lieu of, Contractor obtaining and maintaining such policies of insurance. Each of the policies of insurance obtained and maintained by a Subcontractor hereunder shall conform with the requirements of this Article 6. Upon request of the District, Contractor shall promptly deliver to the District Certificates of Insurance evidencing that the Subcontractors have obtained and maintained policies of insurance in conformity with the requirements of this Article 6. Failure or refusal of the Contractor to provide the District with Subcontractors' Certificates of Insurance evidencing the insurance coverages required hereunder is a material default of Contractor hereunder.
- 6.6 Maintenance of Insurance.** Any insurance bearing on the adequacy of performance of Work shall be maintained after the District's Final Acceptance of all of the Work for the full one year correction of Work period and any longer specific guarantee or warranty periods set forth in the Contract Documents. Should such insurance be canceled before the end of any such periods and the Contractor fails to immediately procure replacement insurance as specified, the District reserves the right to procure such insurance and to charge the cost thereof to the Contractor. Nothing contained in these insurance requirements is to be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from its operations or performance of the Work under the Contract Documents, including without limitation the Contractor's obligation to pay Liquidated Damages. In no instance will the District's exercise of its option to occupy and use completed portions of the Work relieve the Contractor of its obligation to maintain insurance required under this Article until the date of Final Acceptance of the Work by the District, or such time thereafter as required by the Contract Documents. The insurer providing any insurance coverage required hereunder shall be to the reasonable satisfaction of the District.
- 6.7 Contractor's Insurance Primary.** All insurance and the coverages thereunder required to be obtained and maintained by Contractor hereunder, if overlapping with any policy of insurance maintained by the District, shall be deemed to be primary and non-contributing with any policy maintained by the District and any policy or coverage thereunder maintained by District shall be deemed excess insurance. To the extent that the District maintains a policy of insurance covering property damage arising out of the perils of fire or other casualty covered by the Contractor's Builder's Risk Insurance or the Comprehensive General Liability Insurance of the Contractor or any Subcontractor, the District, Contractor and all Subcontractors waive rights of subrogation against the others. The costs for obtaining and maintaining the insurance coverages required herein shall be included in the Contract Price.
- 6.8 Indemnity.** Unless arising solely out of the active negligence, gross negligence or willful misconduct the District or the Architect, the Contractor shall indemnify, defend and hold harmless the Indemnified Parties who are: (i) the District and its Board of Trustees, officers, employees, agents and representatives (including the Project Inspector); (ii) the Architect and its consultants for the Work and their respective agents and employees; and (iii) the

Construction Manager and its agents and employees. The Contractor's obligations hereunder includes indemnity, defense and hold harmless of the Indemnified Parties from and against any and all damages, losses, claims, demands or liabilities whether for damages, losses or other relief, including, without limitation attorneys fees and costs which arise, in whole or in part, from the Work, the Contract Documents or the acts, omissions or other conduct of the Contractor, any Subcontractor or any person or entity engaged by them for the Work. The Contractor's obligations under the foregoing include without limitation: (i) injuries to or death of persons; (ii) damage to property; or (iii) theft or loss of property; (iv) Stop Notice claims asserted by any person or entity in connection with the Work; and (v) other losses, liabilities, damages or costs resulting from, in whole or part, any acts, omissions or other conduct of Contractor, any of Contractor's Subcontractors, of any tier, or any other person or entity employed directly or indirectly by Contractor in connection with the Work and their respective agents, officers or employees. The obligations of the Contractor, as set forth in (v) above shall include, without limitation losses, costs, expenses, damages and other claims asserted by any other Contractor to the District in connection with the Work or in connection with a work of improvement related to or affected by the Work. If any action or proceeding, whether judicial, administrative, arbitration or otherwise, shall be commenced on account of any claim, demand or liability subject to Contractor's obligations hereunder, and such action or proceeding names any of the Indemnified Parties as a party thereto, the Contractor shall, at its sole cost and expense, defend the named Indemnified Parties in such action or proceeding with counsel reasonably satisfactory to the named Indemnified Parties. In the event that there shall be any judgment, award, ruling, settlement, or other relief arising out of any such action or proceeding to which any of the Indemnified Parties are subject to, or bound by, Contractor shall pay, satisfy or otherwise discharge any such judgment, award, ruling, settlement or relief; Contractor shall indemnify and hold harmless the Indemnified Parties from any and all liability or responsibility arising out of any such judgment, award, ruling, settlement or relief. The Contractor's obligations hereunder are binding upon Contractor's Performance Bond Surety and these obligations shall survive notwithstanding Contractor's completion of the Work or the termination of the Contract.

- 6.9 Payment Bond; Performance Bond.** Prior to commencement of the Work, the Contractor shall furnish a Performance Bond as security for Contractor's faithful performance of the Contract and a Labor and Material Payment Bond as security for payment of persons or entities performing work, labor or furnishing materials in connection with Contractor's performance of the Work under the Contract Documents. Unless otherwise stated in the Special Conditions, the amounts of the Performance Bond and the Payment Bond required hereunder shall be one hundred percent (100%) of the Contract Price. Said Labor and Material Payment Bond and Performance Bond shall be in the form and content set forth in the Contract Documents. The failure or refusal of the Contractor to furnish either the Performance Bond or the Labor and Material Payment Bond in strict conformity with this Article 6.9 may be deemed by the District as a default by the Contractor of a material obligation hereunder. Upon request of the Contractor, the District may consider and accept, but is not obligated to do so, multiple sureties on such bonds. The Surety on any bond required under the Contract Documents shall be: (i) an Admitted Surety Insurer as that term is defined in California Code of Civil Procedure §995.120; (ii) A.M. Best rated A- or better; and (iii) A.M. Best Financial Size Category VII or better. The Contractor's delivery of Bonds issued by a Surety who does not meet or exceed each of the criteria set forth above will be rejected.

ARTICLE 7: CONTRACT TIME

7.1 Substantial Completion of the Work Within Contract Time. Unless otherwise expressly provided in the Contract Documents, the Contract Time is the period of time, including authorized adjustments thereto, allotted in the Contract Documents for achieving Substantial Completion of the Work. The date for commencement of the Work is the date established by the Notice to Proceed issued by the District pursuant to the Agreement, which shall not be postponed by the failure to act of the Contractor or of persons or entities for whom the Contractor is responsible. The date of Substantial Completion is the date certified by the Architect and the Project Inspector as such in accordance with the Contract Documents.

7.2 Progress and Completion of the Work.

7.2.1 Time of Essence. Time limits stated in the Contract Documents are of the essence. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing and achieving Substantial Completion of the Work. The Contractor shall employ and supply a sufficient force of workers, material and equipment, and prosecute the Work with diligence so as to maintain progress, to prevent Work stoppage and to achieve Substantial Completion of the Work within the Contract Time.

7.2.2 Substantial Completion. Substantial Completion is that stage in the progress of the Work when the Work is complete in accordance with the Contract Documents so the District can occupy or use the Work for its intended purpose. Substantial Completion shall be determined by the Architect, the Construction Manager and the Project Inspector upon request by the Contractor in accordance with the Contract Documents. The good faith and reasonable determination of Substantial Completion by the Project Inspector, the Construction Manager and the Architect shall be controlling and final.

7.2.3 Correction or Completion of the Work After Substantial Completion.

7.2.3.1 Punchlist. Upon achieving Substantial Completion of the Work, the District, The Project Inspector, the Construction Manager, the Architect and the Contractor shall jointly review the Work and prepare a comprehensive list of items of the Work to be corrected or completed by the Contractor (“the Punchlist”). The exclusion of, or failure to include, any item on the Punchlist shall not alter or limit the obligation of the Contractor to complete or correct any portion of the Work in accordance with the Contract Documents.

7.2.3.2 Time for Completing Punchlist Items. In addition to setting forth items for correction or completion pursuant to Article 7.2.3.1, the Construction Manager, if any, Contractor and Architect shall, after the jointly review, establish a reasonable time for Contractors’ completion of all Punchlist items. If mutual agreement is not reached for the Contractor’s completion of Punchlist items, the Architect shall determine such time, and in such event, the time determined by the Architect shall be final and binding upon the District and Contractor so long as the Architect’s determination is made in good faith. The Contractor shall promptly and diligently proceed to complete all Punchlist items within the time established. In the event that the Contractor shall fail or refuse, for any reason, to complete all Punchlist items within the time established, Contractor shall be subject to assessment of Liquidated Damages in accordance with Article 7.4 hereof. The foregoing notwithstanding, if the Contractor fails or refuses to complete all Punchlist items, the District may in its sole and exclusive discretion and without further notice to Contractor, elect to cause the completion of all remaining Punchlist items provided, however that such election by the District is in addition to

and not in lieu of any other right or remedy of the District under the Contract Documents or at law. If the District elects to complete Punchlist items of the Work, pursuant to the foregoing, Contractor shall be responsible for all costs incurred by the District in connection herewith and the District may deduct such costs from the Contract Price then or thereafter due the Contractor, if these costs exceed the remaining Contract Price due to the Contractor, the Contractor and the Performance Bond Surety are liable to District for any such excess costs

7.2.4 Final Completion. Final Completion is that stage of the Work when all Work has been completed in accordance with the Contract Documents, including without limitation, the performance of all correction or completion items noted upon Substantial Completion, and the Contract has been otherwise fully performed by the Contractor. Final Completion shall be determined by the Architect and the Project Inspector upon request of the Contractor. The good faith and reasonable determination of Final Completion by the Project Inspector and the Architect shall be controlling and final.

7.2.5 Contractor Responsibility for Multiple Inspections. In the event the Contractor shall request determination of Substantial Completion or Final Completion by the Project Inspector and the Architect and it is determined by the Project Inspector and the Architect that the Work does not then justify certification of Substantial Completion or Final Completion and re-inspection is required at a subsequent time to make such determination, the Contractor shall be responsible for all costs of such re-inspection, including without limitation, the fees of the Architect and the salary of the Project Inspector. The District may deduct such costs from the Contract Price then due or thereafter due to the Contractor.

7.2.6 Final Acceptance. Final Acceptance of the Work shall occur upon approval of the Work by the District's Board of Trustees; such approval shall be submitted for adoption at the next regularly scheduled meeting of the District's Board of Trustees after the determination of Final Completion. The commencement of any warranty or guarantee period under the Contract Documents shall be deemed to be the date upon which the District's Board of Trustees approves of the Final Acceptance of the Work.

7.3 Construction Schedule.

7.3.1 General Construction Schedule Requirements. Unless otherwise provided in the Special Conditions, the Construction Schedules required under this Article 7 shall; (i) indicate the date(s) for commencement and completion of various portions of the Work including without limitation, procurement, fabrication and delivery of major items, materials or equipment; (ii) indicate manpower and other resources required for completion of each Construction Schedule activity; (iii) indicate costs for completion of each Construction Schedule activity; (iv) identify each Submittal required by the Contract Documents, the date for the Contractor's submission of each Submittal and the date for the return of the reviewed Submittal to the Contractor; (v) no Site activity shall reflect a duration of less than one (1) or more than fifteen (15) working days; (vi) no more than twenty five percent (25%) of the total number of activities shown on any Construction Schedule shall be critical path activities or near critical path activities; "near critical path" is defined as float less than ten (10) working days; (viii) indicate major milestones, including without limitation, development of Punchlists and completion of Punchlists, equipment start-up and testing, close-out activities; and (ix) shall incorporate an activity code structure sufficient to allow future sorting/grouping by responsibility, Site area/location, CSI divisions and Milestones.

Failure by the Contractor to include any element of the Work required by the Contract Documents or completion of the Work shall not excuse the Contractor from completing all work required within the Contract Time, notwithstanding District's, Construction Manager's and Architect's acceptance of any Construction Schedule prepared by the Contractor.

7.3.2 Submittal of Preliminary Construction Schedule. Within ten (10) days following execution of the Agreement, the Contractor shall prepare and submit one (1) electronic and two (2) hard copies to the District, the Construction Manager and the Architect a Preliminary Construction Schedule indicating, in graphic form, the estimated rate of progress and sequence of all Work required under the Contract Documents. Failure of the Contractor to submit the Preliminary Construction Schedule within said ten (10) days will result in assessment of Liquidated Damages as set forth in the Special Conditions for each calendar beyond such ten (10) day period, until the Preliminary Construction Schedule is submitted by the Contractor. The purpose of the Preliminary Construction Schedule is to ensure adequate planning and execution of the Work so that it is completed within the Contract Time and to permit evaluation of the progress of the Work. The Contractor may submit a Preliminary Construction Schedule depicting completion of the Work in a duration shorter than the Contract Time; provided that such Preliminary Construction Schedule shall not be a basis for adjustment to the Contract Price in the event that completion of the Work shall occur after the time depicted therein, nor shall such Preliminary Construction Schedule be the basis for any extension of the Contract Time, the Contractor's entitlement to any extension of the Contract Time shall be based upon the Contract Time and not on any shorter duration which may be depicted in the Contractor's Preliminary Construction Schedule. If the Construction Schedules required under this Article 7.3 incorporate therein any "float" time, such float shall be deemed to jointly belong to and owned by the District and the Contractor. As used herein, "float time" shall be deemed to refer to the time between earliest finish date and the latest finish date of each activity shown on the Construction Schedule.

7.3.3 Review of Preliminary Construction Schedule. The District, the Construction Manager and the Architect shall review the Preliminary Construction Schedule submitted by the Contractor pursuant to Article 7.3.1 above for conformity with the requirements of the Contract Documents. Within fifteen (15) days of the date of receipt of the Preliminary Construction Schedule, the Preliminary Construction Schedule will be returned to the Contractor with comments to the form or content thereof. Review of the Preliminary Progress Schedule and any comments thereto by the District, the Construction Manager and/or the Architect shall not be deemed to be the assumption of construction means, methods or sequences by the District, the Construction Manager or the Architect, all of which remain the Contractor's obligations under the Contract Documents.

7.3.4 Preparation and Submittal of Contract Construction Schedule. Within ten (10) days of the District's return of the Preliminary Construction Schedule to the Contractor pursuant to Article 7.3.2 above, the Contractor shall prepare and submit to the District, Architect and the Construction Manager the Construction Schedule which incorporates therein the comments to the Preliminary Construction Schedule. Upon the Contractor's submittal of such Construction Schedule, the District, the Construction Manager and the Architect shall review the same for purposes of determining conformity with the requirements of the Contract Documents. Within fifteen (15) days of the receipt of the Construction Schedule, the District will accept such Construction Schedule or will return the same to the Contractor with comments to the form or content. In the event there are comments to the form or content thereof, the Contractor, shall within seven (7) days of

receipt of such comments, revise and resubmit the Construction Schedule incorporating therein such comments. Upon the District's acceptance of the form and content of a Construction Schedule, the same shall be deemed the "Accepted Construction Schedule." The District's acceptance of a Construction Schedule shall be for the sole and limited purpose of determining conformity with the requirements of the Contract Documents. By the Accepted Construction Schedule, the District shall not be deemed to have exercised control over, or approval of, construction means, methods or sequences, all of which remain the responsibility and obligation of the Contractor in accordance with the terms of the Contract Documents. Further, the Accepted Construction Schedule shall not operate to limit or restrict any of Contractor's obligations under the Contract Documents nor relieve the Contractor from the full, faithful and timely performance of such obligations in accordance with the terms of the Contract Documents. The activities, commencement and completion dates of activities, and the sequencing of activities depicted on the Accepted Construction Schedule shall not be modified or revised by the Contractor without the prior consent, or direction, of the District, Construction Manager and the Architect. Updates to the Accepted Construction Schedule pursuant to Article 7.3.5 below shall not be deemed revisions to the Accepted Construction Schedule. In the event that the Accepted Construction Schedule shall depict completion of the Work in a duration shorter than the Contract Time, the same shall not be a basis for an adjustment of the Contract Time or the Contract Price in the event that actual completion of the Work shall occur after such the time depicted in such Accepted Construction Schedule. In such event, the Contract Price shall not be subject to adjustment on account of any additional costs incurred by the Contractor to complete the Work prior to the Contract Time, as adjusted in accordance with the terms of the Contract Documents. Any adjustment of the Contract Time or the Contract Price shall be based upon the Contract Time set forth in the Contract Documents and not any shorter duration which may depicted in the Accepted Construction Schedule.

7.3.5 Revisions to Accepted Construction Schedule. In the event that the progress of the Work or the sequencing of the activities of the Work shall materially differ from that indicated in the Accepted Construction Schedule, as determined by the District in its reasonable discretion and judgment, the District may direct the Contractor to revise the Accepted Construction Schedule; within fifteen (15) days of the District's direction, the Contractor shall prepare and submit to the District, Architect and the Construction Manager a revised Accepted Construction Schedule, for review and approval by the District. The Contractor may request consent of the District to revise the Accepted Construction Schedule. Any such request shall be considered by the District only if in writing setting forth the Contractor's proposed revision(s) to the Accepted Construction Schedule and the reason(s) therefor. The District may consent to, or deny, any such request of the Contractor to revise the Accepted Construction Schedule in its reasonable discretion.

7.3.6 Updates to Accepted Construction Schedule.

7.3.6.1 Updated Construction Schedule Requirements. The Contractor shall monitor and update the Accepted Construction Schedule on a monthly basis, or more frequently as required by the conditions or progress of the Work, or as may be requested by the District. The Contractor shall provide the District, the Construction Manager and the Architect with Updated Accepted Construction Schedules indicating progress achieved and activities commenced or completed within the prior Updated Accepted Construction Schedule. Updates to the Accepted Construction Schedule shall not include any revisions to the activities, commencement and completion dates of activities or the sequencing of activities depicted on the Accepted Construction

Schedule. Any such revisions to the Accepted Construction Schedule shall result in the District's rejection of such update and Contractor shall, within seven (7) days of the District's rejection of such update, submit to the Architect and the Construction Manager an Updated Accepted Construction Schedule which does not incorporate any such revisions. The Contractor shall also submit, with its updates to the Accepted Construction Schedule a narrative statement including a description of current and anticipated problem areas of the Work, delaying factors and their impact, and an explanation of corrective action taken or proposed by the Contractor. If the progress of the Work is behind the Accepted Construction Schedule, the Contractor shall indicate what measures will be taken to place the Work back on schedule. The District may, from time to time, and in the District's sole and exclusive discretion, transmit to the Contractor's Performance Bond Surety the Accepted Construction Schedule, any updates thereof and the narrative statement described hereinabove. The District's election to transmit, or not to transmit such information, to the Contractor's Performance Bond Surety shall not limit the Contractor's obligations under the Contract Documents.

7.3.6.2 Monthly Submission of Updated Construction Schedules. Concurrently with its submission of its Applications for Progress Payments, the Contractor shall submit the Updated Construction Schedule for the immediately preceding month. Each submission of a monthly Updated Construction Schedule shall consist of: (i) one (1) reproducible copy; (ii) three (3) color copies; and (iii) electronic file stored on CD or DVD. If a narrative report accompanies any monthly Updated Construction Schedule, the Contractor shall submit four (4) copies of such narratives.

7.3.7 Contractor Responsibility for Construction Schedule. The Contractor shall be responsible for the preparation, submittal and maintenance of the Construction Schedules required by the Contract Documents, and any failure of the Contractor to do so may be deemed by the District as the Contractor's default in the performance of a material obligation of the Contractor under Contract Documents. Any and all costs or expenses required or incurred to prepare, submit, revise, maintain or update the Construction Schedules shall be solely that of the Contractor and no such cost or expense shall be charged to the District. The Contract Price shall not be subject to adjustment on account of costs, fees or expenses incurred or associated with the Contractor's preparation, submittal, and maintenance or updating of the Construction Schedules.

7.3.8 Three (3) Week Look-Ahead Schedule; One (1) Week As Built Schedule. A combined three (3) week Look-Ahead Schedule for the three (3) week period immediately following each weekly Progress Meeting with a one (1) week As-Built Schedule for the previous week shall be prepared by the Contractor and submitted by the Contractor to the Construction Manager for review and approval at each weekly Progress Meeting. The Contractor's preparation and submittal of the Three (3) Week Look-Ahead Schedule; One (1) Week As Built Schedule described above are material obligations of the Contractor; failure or refusal of the Contractor to strictly comply with the foregoing shall be a basis for the District's exercise of the default termination procedures set forth in the Contract Documents.

7.3.9 Unanticipated Unusually Severe Weather Conditions. The Baseline Construction Schedule and all subsequent Construction Schedule Updates shall incorporate a critical path activity entitled "Remaining Inclement Weather Days" which shall be the last activity in each Construction Schedule prior to the activity entitled "Final Completion". The sole

successor to “Remaining Inclement Weather Days” (with zero lag) shall be “Final Completion” and the sole predecessor (with zero lag) shall be “Punchlist”.

The Contractor shall apply in writing to the District to use an Inclement Weather Day only when a critical path activity on the then current Updated Construction Schedule has been delayed because of inclement weather conditions. The duration of the “Remaining Inclement Weather Days” activity shall be reduced by the number of approved work days of actual weather caused delay, and be included in the monthly schedule updates.

The “Remaining Inclement Weather Days” activity shall have an initial duration as set forth in the Special Conditions, Paragraph 4.3. If, at Final Completion, there are inclement weather days remaining, the unused days shall be considered “float” as defined by Paragraph 7.3.1 of the General Conditions. If, additional inclement weather days are required, the District shall adjust the Substantial Completion date accordingly.

7.3.10 Construction Schedules; Conditions Precedent To Progress Payment Disbursements. In addition to, and not in lieu of conditions precedent set forth elsewhere in the Contract Documents relating to the District’s disbursement of Progress Payments, the Contractor’s preparation and submission of the Preliminary Construction Schedule, Construction Schedule Updates and the Three (3) Week Look-Ahead Schedule; One (1) Week As Built Schedule in accordance with the Contract Documents requirements are conditions precedent to the District’s obligation to disburse any Progress Payment to the Contractor.

7.3.11 Contractor Schedule Compliance Obligations. If in the sole reasonable judgment of the District: (i) the Contractor’s progress of Work is materially behind that indicated in the then current Construction Schedule or (ii) the Contractor’s progress of Work will not result in the Contractor’s achievement of Substantial Completion within the Contract Time or the Contractor’s completion of Milestones/Phases of the Work as required by the Contract Documents, the Contractor shall take the action(s) described herein, as directed or authorized by the District. Unless the actions of the District, Construction Manager, Architect or Project Inspector are the sole causative factors resulting in delayed progress of the Work or the inability to achieve Substantial Completion within the Contract Time, the Contractor’s actions hereunder shall not result in adjustment of the Contract Time or the Contract Price. Actions to be directed or authorized by the District include, without limitation, the Contractor’s (i) increase of labor resources (whether on-Site or off-Site); (ii) increase the number of working hours per shift, increase the number of shifts per working day, increase the number of working days and/or increase Construction Equipment at the Site; and/or (iii) re-sequence Work activities to achieve maximum concurrent performance and completion of multiple Work activities.

7.4 Adjustment of Contract Time. If Substantial Completion is delayed, adjustment, if any, to the Contract Time on account of such delay shall be in accordance with this Article 7.4.

7.4.1 Excusable Delays. If Substantial Completion of the Work is delayed by Excusable Delays, the Contract Time shall be subject to adjustment for such reasonable period of time as determined by the Architect; Excusable Delays shall not result in any increase in the Contract Price. Excusable Delays refer to unforeseeable and unavoidable casualties or other unforeseen causes beyond the control, and without fault or neglect, of the Contractor, any Subcontractor, Material Supplier or other person directly or indirectly engaged by the Contractor in performance of any portion of the Work. Excusable Delays

include unanticipated and unavoidable labor disputes, unusual and unanticipated delays in transportation of equipment, materials or Construction Equipment reasonably necessary for completion and proper execution of the Work, unanticipated unusually severe weather conditions or DSA directive to stop the Work. Neither the financial resources of the Contractor or any person or entity directly or indirectly engaged by the Contractor in performance of any portion of the Work shall be deemed conditions beyond the control of the Contractor. If an event of Excusable Delay occurs, the Contract Time shall be subject to adjustment hereunder only if the Contractor establishes: (i) full compliance with all applicable provisions of the Contract Documents relative to the method, manner and time for Contractor's notice and request for adjustment of the Contract Time; (ii) that the event(s) forming the basis for Contractor's request to adjust the Contract Time are outside the reasonable control and without any fault or neglect of the Contractor or any person or entity directly or indirectly engaged by Contractor in performance of any portion of the Work; and (iii) that the event(s) forming the basis for Contractor's request to adjust the Contract Time directly and adversely impacted the critical path of the Work as indicated in the Approved Construction Schedule or the most recent updated Approved Construction Schedule relative to the date(s) of the claimed event(s) of Excusable Delay. The foregoing provisions notwithstanding, if the Special Conditions set forth a number of "Rain Days" to be anticipated during performance of the Work, the Contract Time shall not be adjusted for rain related unusually severe weather conditions until and unless the actual number of Rain Days during performance of the Work shall exceed those noted in the Special Conditions and such additional Rain Days shall have directly and adversely impacted the critical path of the Work as depicted in the Approved Construction Schedule or the most recent updated Approved Construction Schedule relative to the date(s) of such additional Rain Days.

7.4.2 Compensable Delays. If Substantial Completion of the Work is delayed and such delay is caused by the acts or omissions of the District, the Architect, the Inspector of Record, or separate contractor employed by the District (collectively "Compensable Delays"), upon Contractor's request and notice, in strict conformity with Articles 7 and 9 of these General Conditions, the Contract Time will be adjusted by Change Order for such reasonable period of time as determined by the Architect and the District. In accordance with California Public Contract Code §7102, if the Contractor's progress is delayed by any of the events described in the preceding sentence, Contractor shall not be precluded from the recovery of damages directly and proximately resulting therefrom, provided that the District is liable for the delay, the delay is unreasonable under the circumstances involved and the delay was not within the reasonable contemplation of the District and the Contractor at the time of execution of the Agreement. In such event, Contractor's damages, if any, shall be limited to direct, actual and unavoidable additional costs of labor, materials or Construction Equipment directly resulting from such delay, and shall exclude indirect or other consequential damages. Except as expressly provided for herein, Contractor shall not have any other claim, demand or right to adjustment of the Contract Price arising out of delay, interruption, hindrance or disruption to the progress of the Work. Adjustments to the Contract Price and the Contract Time, if any, on account of Changes to the Work or Suspension of the Work shall be governed by the applicable provisions of the Contract Documents, including without limitation, Articles 9 and 14 of these General Conditions.

7.4.3 Unexcusable Delays. Unexcusable Delays refer to any delay to the progress of the Work caused by events or factors other than those specifically identified in Articles 7.4.1 and 7.4.2 above. Neither the Contract Price nor the Contract Time shall be adjusted on account of Unexcusable Delays.

7.4.4 Adjustment of Contract Time.

7.4.4.1 Procedure for Adjustment of Contract Time. The Contract Time shall be subject to adjustment only in strict conformity with applicable provisions of the Contract Documents. Failure of Contractor to request adjustment(s) of the Contract Time in strict conformity with applicable provisions of the Contract Documents shall be deemed Contractor's waiver of the same.

7.4.4.1.1 Contractor Notice of Adjustment of Contract Time. The Contract Time shall be subject to adjustment only if the Contractor provides notice of an adjustment of the Contract Time and all supporting substantiation and documentation of the basis and extent of the requested Contract Time adjustment in strict conformity to Article 9.6 of these General Conditions.

7.4.4.1.2 Time Impact Evaluation. The supporting substantiation and documentation of the basis and extent of Contract Time adjustments required by the provisions of Article 9.6 shall include, without limitation, a complete Time Impact Evaluation ("TIE") of the factors justifying an adjustment of the Contract Time and the extent of such adjustment of the Contract Time.

7.4.4.2 Limitations Upon Adjustment of Contract Time on Account of Delays. Any adjustment of the Contract Time on account of an Excusable Delay or a Compensable Delay shall be limited as set forth herein. If an Excusable Delay and a Compensable Delay occur concurrently, the maximum extension of the Contract Time shall be the number of days from the commencement of the first delay to the cessation of the delay which ends last. If an Unexcusable Delay occurs concurrently with either an Excusable Delay or a Compensable Delay, the maximum extension of the Contract Time shall be the number of days, if any, which the Excusable Delay or the Compensable Delay exceeds the period of time of the Unexcusable Delay. In addition to the foregoing limitations upon extension of the Contract Time, no adjustment of the Contract Time shall be made on account of any Excusable Delays or Compensable Delays unless such delay(s) actually and directly impact Work or Work activities on the critical path of the then current and updated Approved Construction Schedule as of the date on which such delay first occurs. The District shall not be deemed in breach of, or otherwise in default of any obligation hereunder, if the District shall deny any request by the Contractor for an adjustment of the Contract Time for any delay which does not actually and directly impact Work or Work activities on the critical path of the then current and updated Approved Construction Schedule.

7.5 Liquidated Damages. Should the Contractor neglect, fail or refuse to: (i) submit the Preliminary Construction Schedule within the time set forth in the Contract Documents; (ii) submit Submittals in accordance with Submittal Schedule incorporated into the Accepted Construction Schedule; (iii) achieve Substantial Completion of the Work within the Contract Time, (subject to adjustments authorized under the Contract Documents); or (iv) to complete Punchlist items within the time established pursuant to the Contract Documents, the Contractor agrees to pay to the District the amount of per diem Liquidated Damages set forth in the Special Conditions, not as a penalty but as Liquidated Damages. The Liquidated Damages amounts set forth in the Special Conditions are agreed upon by and between the Contractor and the District because of the difficulty of fixing the District's actual damages in the event of the Contractor's delayed submission of the Preliminary Construction Schedule, delayed submission of Submittals, delayed Substantial Completion or delayed completion of

Punchlist items. The Contractor and the District specifically agree that said amounts are reasonable estimates of the District's damages in such event, and that such amounts do not constitute a penalty. Liquidated Damages may be deducted by the District from the Contract Price then or thereafter due the Contractor. The Contractor and the Surety shall be liable to the District for any Liquidated Damages exceeding any amount of the Contract Price then held or retained by the District. In the event that the Contractor shall fail or refuse to complete Punchlist items and the District elects to exercise its right to cause completion or correction of such items pursuant to Article 7.2.3.2 hereof, the District's assessment of Liquidated Damages pursuant to the foregoing shall be in addition, and not in lieu of, the District's right to charge Contractor with the cost of completing or correcting such items of the Work, as provided for under Article 7.2.3.2. The Contractor and the District acknowledge and agree that the provisions of this Article 7.5 are reasonable under the circumstances existing at the time of the Contractor's execution of the Agreement.

- 7.6 District Right to Take-Over Work.** Unless caused by the District, Architect, Construction Manager or the Project Inspector, if the Contractor fails or refuses, for any reason and at any time, to furnish adequate materials, labor, equipment or services to maintain progress of the Work in accordance with the then current Construction Schedule after twenty-four (24) hours advance written notice from the Construction Manager to the Contractor of its failure or refusal, the District may thereafter furnish or cause to be furnish such materials, labor, equipment or services necessary to maintain progress of the Work in accordance with the then current Construction Schedule. All costs, expenses or other charges (whether direct, indirect and administrative) incurred by the District in furnishing such materials, labor, equipment or services shall be at the sole cost of the Contractor and the District may deduct the same from the Contract Price then or thereafter due the Contractor. The District's exercise of rights pursuant to the foregoing shall not be deemed a waiver or limitation of any other right or remedy of the District under the Contract Documents.

ARTICLE 8: CONTRACT PRICE

- 8.1 Contract Price.** The Contract Price is the amount stated in the Agreement as such, and subject to any authorized adjustments thereto in accordance with the Contract Documents, is the total amount payable by the District to the Contractor for performance of the Work under the Contract Documents. The District's payment of the Contract Price to the Contractor shall be in accordance with the Contract Documents.
- 8.2 Cost Breakdown.** Within fifteen (15) days of the execution of the Agreement by Contractor, Contractor shall furnish, on forms approved by the District, a detailed estimate and complete Cost Breakdown of the Contract Price. The Cost Breakdown shall be subject to review and approval by the Construction Manager, Architect and District of the form and content thereof. In the event that the District shall reasonably object to any portion of the Cost Breakdown, within ten (10) days of the District's receipt of the Cost Breakdown, the District shall notify the Contractor, in writing of the District's objection(s) to the Cost Breakdown. Within five (5) days of the date of the District's written objection(s), Contractor shall submit a revised Cost Breakdown to the District, Architect and the Construction Manager for review and acceptance. The foregoing procedure for the preparation, review and approval of the Cost Breakdown shall continue until the District, Architect and the Construction Manager have approved of the entirety of the Cost Breakdown. Once the Cost Breakdown is accepted by the District, Architect and the Construction Manager, the Cost Breakdown shall not be thereafter modified or amended by the Contractor without the prior consent and approval of the District, Architect and the Construction Manager, which may be granted or withheld in

their sole reasonable discretion.

8.3 Progress Payments.

8.3.1 Applications for Progress Payments. During the Contractor's performance of the Work, the Contractor shall submit monthly, on the first working day of each month, to the Project Inspector, Construction Manager and the Architect, Applications for Progress Payments, on forms approved by the District, setting forth an itemized estimate of Work completed in the preceding month for the purpose of the District's making of Progress Payments thereon. Values utilized in the Applications for Progress Payments shall be based upon the District accepted Cost Breakdown pursuant to Article 8.2 above and such values shall be only for determining the basis of Progress Payments to Contractor, and shall not be considered as fixing a basis for adjustments, whether additive or deductive, to the Contract Price, or for determining the extent of Work actually completed.

8.3.2 Initial Progress Payment Meeting. Prior to submitting any Application for Progress Payment and for the purpose of expediting review of Application for Progress Payments and disbursement of Progress Payments, Contractor agrees to meet with the Project Inspector, Construction Manager and Architect to review and discuss each of the Contractor's Proposed Applications for Progress Payment. If any item submitted for payment is disputed during this review, Contractor agrees to use its best efforts to resolve the disputed items with Project Inspector, Construction Manager and Architect before formally submitting the Application for Progress Payment. The Architect, the Construction Manager and District specifically reserve the right to dispute any item included in Contractor's Application for Progress Payment, regardless of whether such item was identified as disputed in the initial review process provided for herein.

8.3.3 District's Review of Applications for Progress Payments. In accordance with Public Contract Code §20104.50, upon receipt of an Application for Progress Payment, the District shall cause the same to be reviewed by the Project Inspector, the Construction Manager, if one is designated by the District, and the Architect, as soon as is practicable after receipt of such Application for Progress Payment. Such review shall be for the purpose of determining that the Application for Progress Payment is a proper Progress Payment request. For purposes of this Article 8.3.2, an Application for Progress Payment shall be deemed "proper" only if it is submitted on the form approved by the District, with all of the requested information of such form of Application for Progress Payment completely and accurately provided by the Contractor and such completed Application for Progress Payment is accompanied by: (i) a Certification, executed under penalty of perjury by the Contractor's Superintendent and/or Construction Manager, that all weekly Certified Payroll Records for the Contractor and all Subcontractors required to submit weekly Certified Payroll Records under the LCP for the period of time covered by the Application for Progress Payment have been completed and submitted in strict conformity with the LCP; (ii) Certified Payrolls of the any Subcontractors, of any tier, (who are not required under the LCP to submit Certified Payroll Records on weekly basis) for laborers performing any portion of the Work for which a Progress Payment is requested; (iii) duly completed and executed forms of Conditional Waiver and Release of Rights Upon Progress Payment in accordance with California Civil Code §3262 of the Contractor, all Subcontractors of any tier, and Material Suppliers covering the Progress Payment requested; (iv) duly completed and executed forms of Unconditional Waiver and Release of Rights upon Progress Payment in accordance with California Civil Code §3262 of the Contractor, all Subcontractors of any tier, and Material Suppliers covering the Progress Payment received

by the Contractor under the prior Application for Progress Payment; (v) an updated Construction Schedule in accordance with Article 7.3.5 of the General Conditions and applicable provisions of the Specifications relating to the Contractor's updates to the Construction Schedule; (vi) for the first (1st) Application for Progress Payment, a certification that the Preliminary Construction Schedule conforming to requirements of the Contract Documents has been prepared and submitted by the Contractor; for subsequent Applications for Progress Payment a certification by the Contractor that it has continuously maintained, or caused to be maintained, the Record Drawings reflecting the actual as-built conditions of the Work performed for which the Progress Payment is requested, it being understood that such certification is subject to verification by the District, Architect, Project Inspector or the Construction Manager prior to disbursement of the Progress Payment; and (vii) completed/executed form of Debris Recycling Statement. In accordance with Public Contract Code §20104.50, an Application for Progress Payment determined by the District not to be a proper Application for Progress Payment shall be returned by the District to the Contractor as soon as is practicable after receipt of the same from the Contractor, but in no event not more than seven (7) days after the District's receipt thereof. The District's return of any Application for Progress Payment pursuant to the preceding sentence shall be accompanied by a written document setting forth the reason(s) why the Application for Progress Payment is not proper.

8.3.4 Review of Applications for Progress Payments. Upon receipt of an Application for Progress Payment, the Architect, Construction Manager and the Project Inspector shall inspect and verify the Work to determine whether it has been performed in accordance with the terms of the Contract Documents and to determine the portion of the Application for Progress Payment which is properly due to the Contractor under the terms of the Contract Documents.

8.3.5 District's Disbursement of Progress Payments

8.3.5.1 Timely Disbursement of Progress Payments. In accordance with Public Contract Code §20104.50, within thirty (30) days after the District's receipt of a proper Application for Progress Payment, there shall be paid, by District, to Contractor a sum equal to ninety-five percent (95%) of the value of the Work indicated in the Application for Progress Payment which is actually in place as of the date of the Application for Progress Payment and as verified and approved by the Project Inspector and the Architect and the pro rata portion of the Contractor's overhead, supervision and general conditions costs and profit for that month; provided, however, that the District's obligation to disburse any Progress Payment shall be subject to the District's receipt of all documents set forth in Article 8.3.3 above, each and all of which are conditions precedent to the District's obligation to disburse Progress Payments. If an Application for Progress Payment is determined not to be proper due to the failure or refusal of the Contractor to submit documents with the Application for Progress Payment, as required by Article 8.3.2, or incompleteness or inaccuracies in any such documents submitted or if it is reasonably determined that the Record Drawings have not been continuously maintained to reflect the actual as built conditions of the Work completed in the period for which the Progress Payment is requested, the thirty (30) day period hereunder for the District's timely disbursement of a Progress Payment shall be deemed to commence on the date that the District is actually in receipt of documents not submitted with the Application for Progress Payment, or corrections to documents with the Application for Progress Payment so as to render them complete and accurate, or the date upon which the Contractor accurately and fully

completes preparation of the Record Drawings relating to the Work for which the Progress Payment is requested.

8.3.5.2 Untimely Disbursement of Progress Payments. In accordance with Public Contract Code §20104.50, in the event that the District shall fail to make any Progress Payment within thirty (30) days after receipt of an undisputed and properly submitted Application for Progress Payment, the District shall pay the Contractor interest on the undisputed amount of such Application for Progress Payment equal to the legal rate of interest set forth in California Code of Civil Procedure §685.010(a). The foregoing notwithstanding, in the event that the District shall determine that any Application for Progress Payment is not proper, pursuant to Article 8.3.3 above, and the District does not return such Application for Progress Payment within the seven (7) day period provided for in Article 8.3.3, the period of time for the District's disbursement of the Progress Payment on such Application for Progress Payment without incurring the interest liability shall be reduced by the number of days exceeding the seven (7) day return period.

8.3.5.3 District's Right to Disburse Progress Payments by Joint Checks. Provided that the District is in receipt of the applicable Subcontract or Purchase Order, the District, may in its sole discretion, issue joint checks to the Contractor and such Subcontractor or Material Supplier in satisfaction of its obligation to make Progress Payments or the Final Payment due hereunder.

8.3.5.4 No Waiver of Defective or Non-Conforming Work. The approval of any Application for Progress Payment or the disbursement of any Progress Payment to the Contractor shall not be deemed nor constitute acceptance of defective Work or Work not in conformity with the Contract Documents.

8.3.6 Progress Payments for Changed Work. The Contractor's Applications for Progress Payment may include requests for payment on account of Changes in the Work which have been properly authorized and approved by the Project Inspector, the Architect and all other governmental agencies with jurisdiction over such Change in accordance with the terms of the Contract Documents and for which a Change Order has been issued. Except as provided for herein, no other payment shall be made by the District for Changes in the Work.

8.3.7 Materials or Equipment Not Incorporated Into the Work.

8.3.7.1 Limitations Upon Payment. Except as expressly provided for herein, no payments shall be made by the District on account of any item of the Work, including without limitation, materials or equipment which, at the time of the Contractor's submittal of an Application for Progress Payment, has/have not been incorporated into and made a part of the Work.

8.3.7.2 Materials or Equipment Delivered and Stored at the Site. The District may, in its sole and exclusive discretion, make payment for materials or equipment not yet incorporated into the Work if, at or prior to the time of the Contractor's submittal of an Application for Progress Payment incorporating therein a request for payment of such materials or equipment if all of the following are complied with: (i) the materials or equipment have been delivered to the Site; (ii) adequate arrangements, reasonably satisfactory to the District, have been made by the Contractor to store and protect

such materials or equipment at the Site including without limitation, insurance reasonably satisfactory to the District, covering and protecting against the risk of loss, destruction, theft or other damage to such materials or equipment while in storage if such coverage is not afforded under the policy of Builder's Risk insurance obtained by the District pursuant to the Contract Documents; and (iii) the establishment of procedures reasonably satisfactory to the District by which title to such materials or equipment will be vested in the District upon the District's payment therefor. The Contractor acknowledges that the discretion to make, or not to make, payment for materials or equipment delivered or stored at the site of the Work pursuant to the preceding sentence shall be exercised exclusively by the District; the District's exercise of discretion not to make payment for materials or equipment delivered or stored at the Site, but not yet incorporated into the Work shall not be deemed the District's default hereunder. In the event that the District shall elect to make payment for materials or equipment delivered and stored at the Site, the costs and expenses incurred to comply with the requirements of (ii) and (iii) of this Article 8.3.6.2 shall be borne solely and exclusively by the Contractor and no payment shall be made by the District on account of such costs and expenses.

8.3.7.3 Materials or Equipment Not Delivered or Stored at the Site. No payments shall be made by the District for materials or equipment to be incorporated into the Work where such materials or equipment have not been delivered or stored at the Site. The foregoing notwithstanding, the District may, in its sole and exclusive discretion, elect to make payment for materials or equipment not incorporated into the Work and which are not delivered or stored at the Site at or prior to the time of the Contractor's submittal of an Application for Progress Payment incorporating therein a request for payment of such materials or equipment provided that each and all of the following have been complied with: (i) adequate arrangements, reasonably satisfactory to the District, have been made by the Contractor to store and protect such materials or equipment which include without limitation, insurance reasonably satisfactory to the District, covering and protecting against the risk of loss, destruction, theft or other damage to such materials or equipment while in storage if coverage for the same is not afforded under the policy of Builder's Risk insurance obtained by the District pursuant to the Contract Documents; and (ii) the establishment of procedures reasonably satisfactory to the District by which title to such materials or equipment will be vested in the District upon the District's payment therefor. The Contractor acknowledges that the discretion to make, or not to make, payment for such materials or equipment pursuant to the preceding sentence shall be exercised exclusively by the District; the District's exercise of discretion not to make payment for such materials or equipment shall not be deemed the District's default hereunder. In the event that the District shall elect to make payment for materials or equipment not at the Site, the costs and expenses incurred to comply with the requirements of (i) and (ii) of this Article 8.3.7.3 shall be borne solely and exclusively by the Contractor and no payment shall be made by the District on account of such costs and expenses.

8.3.7.4 Materials or Equipment in Fabrication or Transit. The provisions of this Article 8.3.7 notwithstanding, the District shall not make any payment on account of any materials or equipment which is in the process of being fabricated or which are in transit to the Site of or other storage location.

8.3.8 Exclusions From Progress Payments. In addition to the District's right to withhold disbursement of any Progress Payment provided for in the Contract Documents, neither

the Contractor's Application for Progress Payment shall include, nor shall the District be obligated to disburse any portion of the Contract Price for amounts which the Contractor does not intend to pay any Subcontractor, of any tier, or Material Supplier because of a dispute or any other reason.

8.3.9 Title to Work. The Contractor warrants that title to all Work covered by an Application for Progress Payment will pass to the District no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Progress Payment, all Work for which a Progress Payment has been previously issued and the Contractor has received payment from the District therefor shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, stop notices, security interests or encumbrances in favor of the Contractor, Subcontractors, Material Suppliers or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

8.3.10 Substitute Security for Retention. In accordance with the provisions of California Public Contract Code §22300, eligible and equivalent securities may be substituted for any monies withheld by the District to ensure the Contractor's performance under the Contract Documents at the request and expense of the Contractor and in conformity with the provisions of California Public Contract Code §22300. The foregoing and the provisions of California Public Contract Code §22300 notwithstanding, failure of the Contractor to request the substitution of eligible and equivalent securities for monies to be withheld by the District prior to the Contractor's submission of its first Application for Progress Payment shall be deemed a waiver of such right.

8.4 Final Payment.

8.4.1 Application for Final Payment. When the Contractor has achieved Final Completion of the Work and has otherwise fully performed its obligations under the Contract Documents, the Contractor shall submit an Application for Final Payment on such form as approved by the District. Thereupon, the Architect and the Project Inspector will promptly make a final inspection of the Work and when the Architect and the Project Inspector find the Work acceptable under the Contract Documents and that the Contract has been fully performed by the Contractor, the Architect and the Project Inspector will thereupon promptly approve the Application for Final Payment, stating that to the best their knowledge, information and belief, the Work has been completed in accordance with the terms of the Contract Documents. The Final Payment shall include the remaining balance of the Contract Price and any retention from Progress Payments previously withheld by the District.

8.4.2 Conditions Precedent to Disbursement of Final Payment. Neither Final Payment nor any remaining Contract Price shall become due until the Contractor submits to the District each and all of the following, the submittal of which are conditions precedent to the District's obligation to disburse the Final Payment: (i) an affidavit or certification by the Contractor that payrolls, bills for materials and other indebtedness incurred in connection with the Work for which the District or the District's property may or might be responsible or encumbered have been paid or otherwise satisfied; (ii) a certificate evidencing that insurance required by the Contract Documents to remain in force after the Contractor's receipt of Final Payment is currently in effect; (iii) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover any period following Final Payment as required by the Contract Documents; (iv) consent of the Surety

on the Labor and Material Payment Bond and Performance Bond, to Final Payment if required; (v) duly completed and executed forms of Conditional or Unconditional Waivers and Releases of rights upon Final Payment of the Contractor, Subcontractors of any tier and Material Suppliers in accordance with California Civil Code §3262, with each of the same stating that there are, or will be, no claims for additional compensation after disbursement of the Final Payment; (vi) Operations and Maintenance manuals and separate warranties provided by any manufacturer or distributor of any materials or equipment incorporated into the Work; (vii) the Record Drawings; (viii) the form of Guarantee included in the Contract Documents duly executed by an authorized representative of the Contractor; (ix) any and all other items or documents required by the Contract Documents to be delivered to the District upon completion of the Work; (x) the completion and submittal of all reports required by the Contract Documents, including without limitation, verified reports required by applicable provisions of the California Code of Regulations; and (xi) if required by the District, such other data establishing payment or satisfaction of obligations such as receipts, releases and waivers of liens, stop notices, claims, security interest or encumbrances arising out of the Contract to the extent and in such form as may be required by the District.

8.4.3 Disbursement of Final Payment. Provided that the District is then in receipt of all documents and other items in Article 8.4.2 above as conditions precedent to the District's obligation to disburse Final Payment, not later than sixty (60) days following Final Acceptance the District shall disburse the Final Payment to the Contractor. Pursuant to California Public Contract Code §7107, if there is any dispute between the District and the Contractor at the time that disbursement of the Final Payment is due, the District may withhold from disbursement of the Final Payment an amount not to exceed one hundred fifty percent (150%) of the amount in dispute.

8.4.4 Waiver of Claims. The Contractor's acceptance of the Final Payment is a waiver and release by the Contractor of any and all claims against the District for compensation or otherwise in connection with the Contractor's performance of the Contract.

8.4.5 Claims Asserted After Final Payment. Any lien, stop notice or other claim filed or asserted after the Contractor's acceptance of the Final Payment by any Subcontractor, of any tier, laborer, Material Supplier or others in connection with or for Work performed under the Contract Documents shall be the sole and exclusive responsibility of the Contractor who further agrees to indemnify, defend and hold harmless the District and its officers, agents, representatives and employees from and against any claims, demands or judgments arising or associated therewith, including without limitation attorneys fees incurred by the District in connection therewith. In the event any lien, stop notice or other claim of any Subcontractor, Laborer, Material Supplier or others performing Work under the Contract Documents remain unsatisfied after Final Payment is made, Contractor shall refund to District all monies that the District may pay or be compelled to pay in discharging any lien, stop notice or other claim, including, without limitation all costs and reasonable attorneys fees incurred by District in connection therewith.

8.5 Withholding of Payments. The District may withhold any Progress Payment or the Final Payment, in whole or in part, or backcharge the Contractor to the extent it may deem advisable to protect the District on account of: (i) defective Work or Work not in conformity with the requirements of the Contract Documents which is not remedied; (ii) failure of the Contractor to make payments when due Subcontractors or Material Suppliers for materials or labor; (iii) claims filed or reasonable evidence of the probable filing of claims by

Subcontractors, laborers, Material Suppliers, or others performing any portion of the Work under the Contract Documents for which the District may be liable or responsible including, without limitation, Stop Notice Claims filed with the District pursuant to California Civil Code §3179 et seq.; (iv) a reasonable doubt that the Contract can be completed for the then unpaid balance of the Contract Price; (v) tax demands filed in accordance with California Government Code §12419.4; (vi) other claims, penalties and/or forfeitures for which the District is required or authorized to retain funds otherwise due the Contractor; (vii) any amounts due from the Contractor to the District under the terms of the Contract Documents; (viii) violations of the LCP or other obligations of the Contractor or any Subcontractor relating to the employment of labor in connection with the Work (including without limitation, delinquent submission of weekly Certified Payroll Records or the submission of inadequate weekly Certified Payroll Records; or (ix) the Contractor's failure to perform any of its obligations under the Contract Documents or its default under the Contract Documents or its failure to maintain adequate progress of the Work. In addition to the foregoing, the District shall not be obligated to process any Application for Progress Payment or Final Payment, nor shall Contractor be entitled to any Progress Payment or Final Payment so long as any lawful or proper direction concerning the Work or the performance thereof or any portion thereof, given by the District, the Project Inspector, the Architect or any public authority having jurisdiction over the Work, or any portion thereof, shall not be fully and completely complied with by the Contractor. When the District is reasonably satisfied that the Contractor has remedied any such deficiency, payment shall be made of the amount withheld. In lieu of making payment of withheld amounts to the Contractor, the District may, in its sole exclusive discretion, apply withheld amounts to the payment and satisfactions of debts and obligations of the Contractor relating to the Work. In doing, the District shall be an agent of the Contractor for the sole and limited purpose of making payment(s) to others for the Work on behalf of the Contractor; payments made by the District pursuant to the foregoing shall be deemed payments to the Contractor and the Contract Price shall be adjusted to reflect such payment(s). The District shall not be liable to the Contractor or others for its good faith decision to make or not make payment(s) of amounts withheld from the Contractor pursuant to the foregoing. If the District elects to make payments to other of amounts withheld from the Contractor, the District may do so without prior judicial determination; the District will render the Contractor a complete and accurate accounting of amounts withheld and paid to others on behalf of the Contractor.

8.6 Payments to Subcontractors. The Contractor shall pay all Subcontractors for and on account of Work of the Contract performed by such Subcontractors in accordance with the terms of their respective subcontracts and as provided for pursuant to California Public Contract Code §10262, the provisions of which are deemed incorporated herein by this reference. In the event of the Contractor's failure to make payment to Subcontractors in conformity with California Public Contract Code §10262, the provisions of California Public Contract Code §10253 shall apply; by this reference, the provisions of California Public Contract Code §10253 are incorporated herein in its entirety, except that the references in said Section 10253 to "the director" shall be deemed to refer to the District. The Contractor shall timely make payment of retention due Subcontractors in accordance with Public Contract Code §7107.

8.7 Computerized Job Cost Reporting System.

8.7.1 Job Cost Reporting. The Contractor and each Subcontractor with a Subcontract valued at Five Hundred Thousand Dollars (\$500,000) or greater shall maintain a computerized job cost reporting system conforming to the requirements set forth herein.

The computer program(s) utilized by the Contractor and applicable Subcontractors shall be subject to the review and acceptance by the District. The job cost reporting systems for the Work shall be updated in regular intervals of not less than one (1) calendar month.

8.7.2 Job Cost Reporting System Requirements. The computerized job cost programs utilized by the Contractor and applicable Subcontractors shall conform and comply with generally accepted accounting principles applied in a consistent manner and with recognized and generally accepted construction industry accounting standards, guidelines and procedures. The job cost reporting system format and configuration shall follow the general format of the District approved Cost Breakdown and budgets established for each line item shall be traceable to a bid estimate of costs. The job cost reporting systems utilized by the Contractor and applicable Subcontractors shall be capable of: (a) providing overall cost status on a monthly and cumulative basis; (b) providing comparative analysis of the original budgeted costs, actual costs, remaining budget, and projected cost of completion; the job cost reporting system shall be capable of providing comparative analysis for individual line items and the totality of the Work reflected in the job cost report and; (c) tracking adjustments to original budget amounts for Changes to the Work (including, without limitation, issued, pending and potential Change Orders).

8.7.3 Job Cost System Information. Upon request of the District or the Construction Manager, the Contractor and applicable Subcontractors shall make available written job cost reports and provide the District and the Construction Manager with the electronic files of the then current or requested job cost report. The Contractor's obligations hereunder are material.

ARTICLE 9: CHANGES

9.1 Changes in the Work. The District, at any time, by written order, may make Changes within the general scope of the Work under the Contract Documents or issue additional instructions, require additional Work or direct deletion of Work. The Contractor shall not proceed with any Change involving an increase or decrease in the Contract Price or the Contract Time without prior written authorization from the District. The foregoing notwithstanding, the Contractor shall promptly commence and diligently complete any Change to the Work subject to the District's written authorized issued pursuant to the preceding sentence; the Contractor shall not be relieved or excused from its prompt commencement and diligent completion of any Change subject to the District's written authorization by virtue of the absence or inability of the Contractor and the District to agree upon the extent of any adjustment to the Contract Time or the Contract Price on account of such Change. The issuance of a Change Order pursuant to this Article 9 in connection with any Change authorized by the District under this Article 9.1 shall not be deemed a condition precedent to Contractor's obligation to promptly commence and diligently complete any such Change authorized by the District hereunder. The District's right to make Changes shall not invalidate the Contract nor relieve the Contractor of any liability or other obligations under the Contract Documents. Any requirement of notice of Changes in the scope of Work to the Surety shall be the responsibility of the Contractor. Changes to the Work depicted or described in the Drawings or the Specifications shall be subject to approval by the DSA. The District may make Changes to bring the Work or the Project into compliance with environmental requirements or standards established by state or federal statutes and regulations enacted after award of the Contract.

9.2 Oral Order of Change in the Work. Any oral order, direction, instruction, interpretation, or determination from the District, the Project Inspector or the Architect which in the opinion of

the Contractor causes any change to the scope of the Work, or otherwise requires an adjustment to the Contract Price or the Contract Time, shall be treated as a Change only if the Contractor gives the Architect and the Project Inspector written notice within ten (10) days of the order, directions, instructions, interpretation or determination and prior to acting in accordance therewith. Time is of the essence in Contractor's written notice pursuant to the preceding sentence so that the District can promptly investigate and consider alternative measures to address the order, direction, instruction, interpretation or determination giving rise to Contractor's notice. Accordingly, Contractor acknowledges that its failure, for any reason, to give written notice within ten (10) days of such order, direction, instruction, interpretation or determination shall be deemed Contractor's waiver of any right to assert or claim any entitlement to an adjustment of the Contract Time or the Contract Price on account of such order, direction, instruction, interpretation or determination. The written notice shall state the date, circumstances, extent of adjustment to the Contract Price or the Contract Time, if any, requested, and the source of the order, directions, instructions, interpretation or determination that the Contractor regards as a Change. Unless the Contractor acts in strict accordance with this procedure, any such order, direction, instruction, interpretation or determination shall not be treated as a Change and the Contractor hereby waives any claim for any adjustment to the Contract Price or the Contract Time on account thereof.

9.3 Contractor Submittal of Data. Within ten (10) days after receipt of a written order directing a Change in the Work or furnishing the written notice regarding any oral order directing a Change in the Work, the Contractor shall submit to the Architect, the Project Inspector, the Construction Manager and the District a detailed written statement setting forth the general nature of the Change, the amount of any adjustment to the Contract Price on account thereof, properly itemized and supported by sufficient substantiating data to permit evaluation of the same, and the extent of adjustment of the Contract Time, if any, required by such Change. No claim or adjustment to the Contract Price or the Contract Time shall be allowed if not asserted by the Contractor in strict conformity herewith or if asserted after Final Payment is made under the Contract Documents.

9.4 Adjustment to Contract Price and Contract Time on Account of Changes to the Work.

9.4.1 Adjustment to Contract Price. Adjustments to the Contract Price due to Changes in the Work shall be determined by application of one of the following methods, in the following order of priority:

9.4.1.1 Mutual Agreement. By negotiation and mutual agreement, on a lump sum basis, between the District and the Contractor on the basis of the estimate of the actual and direct increase or decrease in costs on account of the Change. Upon request of the District or the Architect, the Contractor shall provide a detailed estimate of increase or decrease in costs directly associated with performance of the Change along with cost breakdowns of the components of the Change and supporting data and documentation. The Contractor's estimate of increase or decrease in costs pursuant to the foregoing, if requested, shall be in sufficient detail and in such form as to allow the District, the Project Inspector and the Architect to review and assess the completeness and accuracy thereof. The Contractor shall be solely responsible for any additional costs or additional time arising out of, or related in any manner to, its failure to provide the estimate of costs within the time specified in the request of the District or the Architect for such estimate.

9.4.1.2 Determination by the District. By the District, whether or not negotiations are

initiated pursuant to Article 9.4.1.1 above based upon actual and necessary costs incurred by the Contractor as determined by the District on the basis of the Contractor's records. In the event that the procedure set forth in this Article 9.4.1.2 is utilized to determine the extent of adjustment to the Contract Price on account of Changes to the Work, promptly upon determining the extent of adjustment to the Contract Price, the District shall notify the Contractor in writing of the same; the Contractor shall be deemed to have accepted the District's determination of the amount of adjustment to the Contract Price on account of a Change to the Work unless Contractor shall notify the District, the Architect and the Project Inspector, in writing, not more than fifteen (15) days from the date of the District's written notice, of any objection to the District's determination. Failure of the Contractor to timely notify the District, the Architect and the Project Inspector of Contractor's objections to the District's determination of the extent of adjustment to the Contract Price shall be deemed Contractor's acceptance of the District's determination and a waiver of any right or basis of the Contractor to thereafter protest or otherwise object to the District's determination. Notwithstanding any objection of the Contractor to the District's determination of the extent of any adjustment to the Contract Price pursuant to this Article 9.4.1.2, Contractor shall, pursuant to Article 9.7 below, diligently proceed to perform and complete any such Change.

9.4.1.3 Basis for Adjustment of Contract Price. If Changes in the Work require an adjustment of the Contract Price pursuant to Articles 9.4.1.1 or 9.4.1.2 above, the basis for adjustment of the Contract Price shall be as follows:

9.4.1.3.1 Labor. Contractor shall be compensated for the costs of labor actually and directly utilized in the performance of the Change. Such labor costs shall be limited to field labor for which there is a prevailing wage rate classification. Wage rates for labor shall not exceed the prevailing wage rates in the locality of the Site and shall be in the labor classification(s) necessary for the performance of the Change. Use of a labor classification which would increase labor costs associated with any Change shall not be permitted. Labor costs shall exclude costs incurred by the Contractor in preparing estimate(s) of the costs of the Change, in the maintenance of records relating to the costs of the Change, coordination and assembly of materials and information relating to the Change or performance thereof, or the supervision and other overhead and general conditions costs associated with the Change or performance thereof.

9.4.1.3.2 Materials and Equipment. Contractor shall be compensated for the costs of materials and equipment necessarily and actually used or consumed in connection with the performance of Changes. Costs of materials and equipment may include reasonable costs of transportation from a source closest to the site of the Work and delivery to the Site. If discounts by Material Suppliers are available for materials necessarily used in the performance of Changes, they shall be credited to the District. If materials and/or equipment necessarily used in the performance of Changes are obtained from a supplier or source owned in whole or in part by the Contractor, compensation therefor shall not exceed the current wholesale price for such materials or equipment. If, in the reasonable opinion of the District, the costs asserted by the Contractor for materials and/or equipment in connection with any Change is excessive, or if the Contractor fails to provide satisfactory evidence of the actual costs of such materials and/or equipment from its supplier or vendor of the same, the costs of such materials

and/or equipment and the District's obligation for payment of the same shall be limited to the then lowest wholesale price at which similar materials and/or equipment are available in the quantities required to perform the Change. The District may elect to furnish materials and/or equipment for Changes to the Work, in which event the Contractor shall not be compensated for the costs of furnishing such materials and/or equipment or any mark-up thereon.

9.4.1.3.3 Construction Equipment. Contractor shall be compensated for the actual cost of the necessary and direct use of Construction Equipment in the performance of Changes to the Work. Use of such Construction Equipment in the performance of Changes to the Work shall be compensated in increments of fifteen (15) minutes. Rental time for Construction Equipment moved by its own power shall include time required to move such Construction Equipment to the site of the Work from the nearest available rental source of the same. If Construction Equipment is not moved to the Site by its own power, Contractor will be compensated for the loading and transportation costs in lieu of rental time. The foregoing notwithstanding, neither moving time or loading and transportation time shall be allowed if the Construction Equipment is used for performance of any portion of the Work other than Changes to the Work. Unless prior approval in writing is obtained by the Contractor from the Architect, the Project Inspector and the District, no costs or compensation shall be allowed for time while Construction Equipment is inoperative, idle or on standby, for any reason. The Contractor shall not be entitled to an allowance or any other compensation for Construction Equipment or tools used in the performance of Changes to the Work where such Construction Equipment or tools have a replacement value of \$500.00 or less. Construction Equipment costs claimed by the Contractor in connection with the performance of any Change to the Work shall not exceed rental rates established by distributors or construction equipment rental agencies in the locality of the Site; any costs asserted which exceed such rental rates shall not be allowed or paid. Unless otherwise specifically approved in writing by the Architect, the Project Inspector and the District, the allowable rate for the use of Construction Equipment in connection with Changes to the Work shall constitute full compensation to the Contractor for the cost of rental, fuel, power, oil, lubrication, supplies, necessary attachments, repairs or maintenance of any kind, depreciation, storage, insurance, labor (exclusive of labor costs of the Construction Equipment operator), and any all other costs incurred by the Contractor incidental to the use of such Construction Equipment.

9.4.1.3.4 Mark-up on Costs of Changes to the Work. In determining the cost to the District and the extent of increase to the Contract Price resulting from a Change adding to the Work, the allowance for mark-ups on the costs of the Change for all overhead (including home office and field overhead), general conditions costs and profit associated with the Change shall not exceed the percentage set forth in the Special Conditions, regardless of the number of Subcontractors, of any tier, performing any portion of any Change to the Work. If a Change to the Work reduces the Contract Price, no profit, general conditions or overhead costs shall be paid by the District to the Contractor for the reduced or deleted Work. In such event, the adjustment to the Contract Price shall be the actual cost reduction realized by the reduced or deleted Work multiplied by the percentage set forth in the Special Conditions for mark-ups on the cost of a Change adding to the scope of the Work.

9.4.1.3.5 Contractor Maintenance of Records. In the event that Contractor shall be directed to perform any Changes to the Work pursuant to Article 9.1 or 9.2, or should the Contractor encounter conditions which the Contractor, pursuant to Article 9.6, believes would obligate the District to adjust the Contract Price and/or the Contract Time, Contractor shall maintain detailed records on a daily basis. Such records shall include without limitation hourly records for labor and Construction Equipment and itemized records of materials and equipment used that day in connection with the performance of any Change to the Work. In the event that more than one Change to the Work is performed by the Contractor in a calendar day, Contractor shall maintain separate records of labor, Construction Equipment, materials and equipment for each such Change. In the event that any Subcontractor, of any tier, shall provide or perform any portion of any Change to the Work, Contractor shall require that each such Subcontractor maintain records in accordance with this Article. Each daily record maintained hereunder shall be signed by Contractor's Superintendent or Contractor's authorized representative; such signature shall be deemed Contractor's representation and warranty that all information contained therein is true, accurate, complete and relate only to the Change referenced therein. All records maintained by a Subcontractor, of any tier, relating to the costs of a Change to the Work shall be signed by such Subcontractor's authorized representative or Superintendent. All records maintained hereunder shall be subject to inspection, review and/or reproduction by the District, the Architect or the Project Inspector upon request. In the event that Contractor shall fail or refuse, for any reason, to maintain or make available for inspection, review and/or reproduction such records and the adjustment to the Contract Price on account of any Change to the Work is determined pursuant to this Article, the District's reasonable good faith determination of the extent of adjustment to the Contract Price on account of such Change shall be final, conclusive, dispositive and binding upon Contractor. Contractor's obligation to maintain records hereunder is in addition to, and not in lieu of, any other Contractor obligation under the Contract Documents with respect to Changes to the Work.

9.4.2 Adjustment to Contract Time. In the event of any Change(s) to the Work pursuant to this Article 9, the Contract Time shall be extended or reduced by Change Order for a period of time commensurate with the time reasonably necessary to perform such Change. In the event that any Change shall require an extension of the Contract Time, the Contractor shall not be subject to Liquidated Damages for such period of time. If completion of the Work is delayed by causes for which the District is responsible and the delay is unreasonable under the circumstances involved, and not within the contemplation of the Contractor and the District at the time of execution of the Agreement, the Contractor shall not be precluded from the recovery of damages arising therefrom.

9.4.3 Addition or Deletion of Alternate Bid Item(s). If the Bid for the Work includes proposal(s) for Alternate Bid Item(s), during Contractor's performance of the Work, the District may elect, pursuant to this Article to add any such Alternate Bid Item(s) if the same did not form a basis for award of the Contract or delete any such Alternate Bid Item(s) if the same formed a basis for award of the Contract. If the District elects to add or delete any such Alternate Bid Item(s) pursuant to the foregoing, the cost or credit for such Alternate Bid Item(s) shall be as set forth in the Contractor's Bid. If any Alternate Bid Item is added or deleted from the Work pursuant to the foregoing, the Contract Time shall be adjusted by the number of days allocated for the added or deleted Alternate Bid Item in the

Contract Documents; if days are not allocated for any Alternate Bid Item added or deleted pursuant to the foregoing, the Contract Time shall be equitably adjusted.

9.5 Change Orders. If the District approves of a Change, a written Change Order prepared by the Architect on behalf of the District shall be forwarded to the Contractor describing the Change and setting forth the adjustment to the Contract Time and the Contract Price, if any, on account of such Change. All Change Orders shall be in full payment and final settlement of all claims for direct, indirect and consequential costs, including without limitation, costs of delays or impacts related to, or arising out of, items covered and affected by the Change Order, as well as any adjustments to the Contract Time. Any claim or item relating to any Change incorporated into a Change Order not presented by the Contractor for inclusion in the Change Order shall be deemed waived. The Contractor shall execute the Change Order prepared pursuant to the foregoing; once the Change Order has been prepared and forwarded to the Contractor for execution, without the prior approval of the District which may be granted or withheld in the sole and exclusive discretion of the District, the Contractor shall not modify or amend the form or content of such Change Order, or any portion thereof. The Contractor's attempted or purported modification or amendment of any such Change Order, without the prior approval of the District, shall not be binding upon the District; any such unapproved modification or amendment to such Change Order shall be null, void and unenforceable. Unless otherwise expressly provided for in the Contract Documents or in the Change Order, any Change Order issued hereunder shall be binding upon the District only upon action of the District's Board of Trustees approving and ratifying such Change Order. In the event of any amendment or modification made by the Contractor to a Change Order for which there is no prior approval by the District, in accordance with the provisions of this Article 9.5, unless otherwise expressly stated in its approval and ratification of such Change Order, any action of the Board of Trustees to approve and ratify such Change Order shall be deemed to be limited to the Change Order as prepared by the Architect; such approval and ratification of such Change Order shall not be deemed the District's approval and ratification of any unapproved amendment or modification by the Contractor to such Change Order. Change Orders shall be issued on the form of Change Order and the content thereof, as attached to the Special Conditions.

9.6 Contractor Notice of Changes. If the Contractor should claim that any instruction, request, the Drawings, the Specifications, action, condition, omission, default, or other situation obligates the District to increase the Contract Price or to extend the Contract Time, the Contractor shall notify the District, Construction Manager, Project Inspector and the Architect, in writing, of such claim within ten (10) days from the date of its actual or constructive notice of the factual basis supporting the same. The District shall consider any such claim of the Contractor only if sufficient supporting documentation is submitted with the Contractor's notice to the District, Construction Manager, Project Inspector and the Architect. Time is of the essence in Contractor's written notice pursuant to the preceding sentence so that the District can promptly investigate and consider alternative measures to the address such instruction, request, Drawings, Specifications, action, condition, omission, default or other situation. Accordingly, Contractor acknowledges that its failure, for any reason, to give written notice (with sufficient supporting documentation to permit the District's review and evaluation) within ten (10) days of its actual or constructive knowledge of any instruction, request, Drawings, Specifications, action, condition, omission, default or other situation for which the Contractor believes there should an adjustment of the Contract Time or the Contract Price shall be deemed Contractor's waiver, release, discharge and relinquishment of any right to assert or claim any entitlement to an adjustment of the Contract Time or the Contract Price on account of any such instruction, request, Drawings, Specifications, action, condition,

omission, default or other situation. In the event that the District determines that the Contract Price or the Contract Time are subject to adjustment based upon the events, circumstances and supporting documentation submitted with the Contractor's written notice under this Article 9.6, any such adjustment shall be determined in accordance with the provisions of Articles 9.4.1 and 9.4.2.

- 9.7 Disputed Changes.** In the event of any dispute or disagreement between the Contractor and the District or the Architect regarding the characterization of any item as a Change to the Work or as to the appropriate adjustment of the Contract Price or the Contract Time on account thereof, the Contractor shall promptly proceed with the performance of such item of the Work, subject to a subsequent resolution of such dispute or disagreement in accordance with the terms of the Contract Documents. The Contractor's failure or refusal to so proceed with such Work may be deemed to be Contractor's default of a material obligation of the Contractor under the Contract Documents.
- 9.8 Emergencies.** In an emergency affecting the safety of life, or of the Work, or of property, the Contractor, without special instruction or prior authorization from the District or the Architect, is permitted to act at its discretion to prevent such threatened loss or injury. Any compensation claimed by the Contractor on account of such emergency work shall be submitted and determined in accordance with this Article 9.
- 9.9 Minor Changes in the Work.** The Architect may order minor Changes in the Work not involving an adjustment in the Contract Price or the Contract Time and not inconsistent with the intent of the Contract Documents. Such Changes shall be effected by written order and shall be binding on the District and the Contractor. The Construction Manager or the Project Inspector may direct the Contractor to perform Changes provided that each such Change does not result in an increase of more than \$500.00 to the Contract Price and no adjustment of the Contract Time. The Contractor shall carry out such orders promptly.
- 9.10 Unauthorized Changes.** Any Work beyond the extent of Work shown on the Contract Documents, or any extra Work performed or provided by the Contractor without notice to the Architect, the Construction Manager and the Project Inspector in the manner and within the time set forth in Articles 9.2 or 9.6 shall be considered unauthorized and at the sole expense of the Contractor. Work so done will not be measured or paid for, no extension to the Contract Time will be granted on account thereof and any such Work may be ordered removed at the Contractor's sole cost and expense. The failure of the District to direct or order removal of such Work shall not constitute acceptance or approval of such Work nor relieve the Contractor from any liability on account thereof.

ARTICLE 10: SEPARATE CONTRACTORS

- 10.1 District's Right to Award Separate Contracts.** The District reserves the right to perform construction or operations related to the Project with the District's own forces or to award separate contracts in connection with other portions of the Project or other construction or operations at or about the Site. If the Contractor claims that delay or additional cost is involved because of such action by the District, the Contractor shall seek an adjustment to the Contract Price or the Contract Time as provided for in the Contract Documents. Failure of the Contractor to request such an adjustment of the Contract Time or the Contract Price in strict conformity with the provisions of the Contract Documents applicable thereto shall be deemed a waiver of the same.

- 10.2 District's Coordination of Separate Contractors.** The District shall provide for coordination of the activities of the District's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the District in reviewing their respective Construction Schedules when directed to do so. The Contractor shall make any revisions to the Approved Construction Schedule for the Work hereunder deemed necessary after a joint review and mutual agreement. The Construction Schedules shall then constitute the Construction Schedules to be used by the Contractor, separate contractors and the District until subsequently revised.
- 10.3 Mutual Responsibility.** The Contractor shall afford the District and separate contractors' reasonable opportunity for storage of their materials and equipment and performance of their activities at the Site and shall connect and coordinate the Contractor's Work, construction and operations with theirs as required by the Contract Documents.
- 10.4 Discrepancies or Defects.** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the District or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect and the Project Inspector any apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor to so report shall constitute an acknowledgment that the District's or separate contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then discoverable by the Contractor's reasonable diligence.

ARTICLE 11: TESTS AND INSPECTIONS

11.1 Tests; Inspections; Observations.

- 11.1.1 Contractor's Notice.** If the Contract Documents, laws, ordinances or any public authority with jurisdiction over the Work requires the Work, or any portion thereof, to be specially tested, inspected or approved, the Contractor shall give the Architect, the Construction Manager and the Project Inspector written notice of the readiness of such Work for observation, testing or inspection at least two (2) working days prior to the time for the conducting of such test, inspection or observation. If inspection, testing or observation is by authority other than the District, the Contractor shall inform the Project Inspector and the Construction Manager not less than two (2) working days prior to the date fixed for such inspection, test or observation. The Contractor shall not cover up any portion of the Work subject to tests, inspections or observations prior to the completion and satisfaction of the requirements of such test, inspection or observation. In the event that any portion of the Work subject to tests, inspection or approval shall be covered up by Contractor prior to completion and satisfaction of the requirements of such tests, inspection or approval, Contractor shall be responsible for the uncovering of such portion of the Work as is necessary for performing such tests, inspection or approval without adjustment of the Contract Price or the Contract Time on account thereof.
- 11.1.2 Cost of Tests and Inspections.** Except as set forth below, the District will pay for fees, costs and expenses to complete the initial tests/inspections of portions of the Work as required by law, code or regulation, provided that such tests/inspections are conducted and completed at a location within a one hundred (100) mile radius of the Site. The foregoing notwithstanding, if the portion(s) of the Work subject to tests/inspections is/are not ready for such test/inspection at the time indicated in the Contractor's notice under

Article 11.1.1 or if upon completion of such test/inspection, the portion(s) of the Work subject to such test/inspection do not meet or exceed the minimum requirements of such test/inspection, the Contractor shall be solely responsible for the payment of all fees, costs or expenses arising out of or related in any manner to subsequent tests/inspections of such portion(s) of the Work. Notwithstanding the District's payment of fees, costs or expenses for conducting initial tests/inspections, if any actions or failures to act of the Contractor or person or entity providing or performing Work under the direction or control of the Contractor require tests/inspections to be conducted over a period of more than eight (8) hours per day by any single person or on weekends/holidays, the Contractor shall be solely responsible for the payment of fees, costs or expenses which result from test/inspection services which exceed eight (8) hours per day by any single person or on weekends/holidays. If any tests/inspections are conducted outside a one hundred (100) mile radius of the Site, the Contractor shall be solely responsible for all costs, fees or expenses to conduct and complete such tests/inspections conducted at such location, including without limitation, costs to complete such tests/inspections and travel, meal and related expenses.

11.1.3 Testing/Inspection Laboratory. The District shall select duly qualified person(s) or testing laboratory(ies) to conduct the tests and inspections to be paid for by the District and required by the Contract Documents. Tests and inspections required of the Work shall be as set forth in the Contract Documents and as required by applicable law, rule or regulation, including without limitation, Title 24 of the California Code of Regulations. Test/inspection standards shall be as set forth in the Contract Documents or established by applicable law, rule or regulation. Where inspection or testing is to be conducted by an independent laboratory or testing agency, materials or samples thereof shall be selected by the laboratory, testing agency, the Project Inspector, the Construction Manager or the Architect and not by the Contractor.

11.1.4 Additional Tests, Inspections and Approvals. If the Architect, the Construction Manager, the Project Inspector or public authorities having jurisdiction over the Work determine that portions of the Work require additional testing, inspection or approval, the Architect will, upon written authorization from the District, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the District, and the Contractor shall give timely notice to the Architect, the Construction Manager and the Project Inspector of when and where tests and inspections are to be made so the Project Inspector and the Architect may observe such procedures. The District shall bear the costs of such additional tests, inspections or approvals, except to the extent that such additional tests, inspections or approvals reveal any failure of the Work to comply with the requirements of the Contract Documents, in which case the Contractor shall bear all costs made necessary by such failures, including without limitation, the costs of corrections, repeat tests, inspections or approvals and the costs of the Architect's services or its consultants in connection therewith.

11.2 Delivery of Certificates. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager.

11.3 Timeliness of Tests, Inspections and Approvals. Tests or inspections required and conducted pursuant to the Contract Documents shall be made or arranged by Contractor to avoid delay in the progress of the Work. Neither the Contract Time nor Contract Price shall be adjusted on account of the failure of the Contractor to timely arrange for the conduct of

required tests/inspections and the Contractor shall be liable to the District for all consequences of such failures, including without limitation, the assessment of Liquidated Damages for delayed Substantial Completion of the Work resulting from such failure of the Contractor.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 Inspection of the Work.

12.1.1 Access to the Work. All Work and all materials and equipment forming a part of the Work or incorporated into the Work are subject to inspection by the District, the Construction Manager, the Architect and the Project Inspector for conformity with the Contract Documents. The Contractor shall, at its cost and without adjustment to the Contract Price or the Contract Time, furnish any facilities necessary for sufficient and safe access to the Work for purposes of inspection by the District, the Construction Manager, the Architect, the Project Inspector, DSA or any other public or quasi-public authority with jurisdiction over the Work or any portion thereof.

12.1.2 Limitations Upon Inspections. Inspections, tests, measurements, or other acts of the Architect, the Construction Manager and the Project Inspector hereunder are for the sole purpose of assisting them in determining that the Work, materials, equipment, progress of the Work, and quantities generally comply and conform with the requirements of the Contract Documents. These acts or functions shall not relieve the Contractor from performing the Work in full compliance with the Contract Documents. No inspection by the Architect or the Project Inspector shall constitute or imply acceptance of Work inspected. Inspection of the Work hereunder is in addition to, and not in lieu of, any other testing, inspections or approvals of the Work required under the Contract Documents.

12.2 Uncovering of Work. If any portion of the Work is covered contrary to the request of the Architect, the Construction Manager, the Project Inspector or the requirements of the Contract Documents, it must, if required by the Architect or the Project Inspector, be uncovered for observation by the Architect, Construction Manager and the Project Inspector and be replaced at the Contractor's expense without adjustment of the Contract Time or the Contract Price.

12.3 Rejection of Work. Prior to the District's Final Acceptance of the Work, any Work or materials or equipment forming a part of the Work or incorporated into the Work which is defective or not in conformity with the Contract Documents may be rejected by the District, the Construction Manager the Architect or the Project Inspector and the Contractor shall correct such rejected Work without any adjustment to the Contract Price or the Contract Time, even if the Work, materials or equipment have been previously inspected by the Architect or the Project Inspector or even if they failed to observe the defective or non-conforming Work, materials or equipment.

12.4 Correction of Work. The Contractor shall promptly correct any portion of the Work rejected by the District, the Construction Manager, the Architect or the Project Inspector for failing to conform to the requirements of the Contract Documents, or which is determined by them to be defective, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. The Contractor shall bear all

costs of correcting destroyed or damaged construction, whether completed or partially completed, of the District or separate contractors, caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents, or which is defective. If the Contractor fails or refuses to correct Work deemed defective or non-conforming pursuant to the foregoing, such failure or refusal shall be deemed the Contractor's default in performance of a material obligation of the Contractor hereunder. In such event, the Contractor's Performance Bond Surety shall be liable for the costs to correct such defective or non-conforming Work and/or securing the performance of an alternative contractor to complete such corrective Work.

12.5 Removal of Non-Conforming or Defective Work. The Contractor shall, at its sole cost and expense, remove from the Site all portions of the Work which are defective or are not in accordance with the requirements of the Contract Documents which are neither corrected by the Contractor nor accepted by the District.

12.6 Failure of Contractor to Correct Work. If the Contractor fails to commence to correct defective or non-conforming Work within 3 days of notice of such condition and promptly thereafter complete the same within a reasonable time, the District may correct it in accordance with the Contract Documents. If the Contractor does not proceed with correction of such defective or non-conforming Work within the time fixed herein, the District may remove it and store the salvable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage after written notice, the District may sell such materials or equipment at auction or at private sale and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Contractor, including without limitation compensation for the Architect's services, attorneys fees and other expenses made necessary thereby. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract Price shall be reduced by the deficiency. If payments of the Contract Price then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor and the Surety shall promptly pay the difference to the District.

12.7 Acceptance of Defective or Non-Conforming Work. The District may, in its sole and exclusive discretion, elect to accept Work which is defective or which is not in accordance with the requirements of the Contract Documents, instead of requiring its removal and correction, in which case the Contract Price shall be reduced as appropriate and equitable.

ARTICLE 13: WARRANTIES

13.1 Workmanship and Materials. The Contractor warrants to the District that all materials and equipment furnished under the Contract Documents shall be new, of good quality and of the most suitable grade and quality for the purpose intended, unless otherwise specified in the Contract Documents. All Work shall be of good quality, free from faults and defects and in conformity with the requirements of the Contract Documents. If required by the Architect or the District, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment incorporated into the Work. Any Work, or portion thereof not conforming to these requirements, including substitutions or alternatives not properly approved in accordance with the Contract Documents may be deemed defective. Where there is an approved substitution of, or alternative to, material or equipment specified in the Contract Documents, the Contractor warrants to the District that such installation, construction, material, or equipment will equally perform the function and have the quality of the originally specified material or equipment. The Contractor expressly warrants the

merchantability, the fitness for use, and quality of all substitute or alternative items in addition to any warranty given by the manufacturer or supplier of such item.

- 13.2 Warranty Work.** If, within one year after the date of Final Acceptance, or such other time frame set forth elsewhere in the Contract Documents, any of the Work is found to be defective or not in accordance with the requirements of the Contract Documents, or otherwise contrary to the warranties contained in the Contract Documents, the Contractor shall commence all necessary corrective action not more than seven (7) days after receipt of a written notice from the District to do so, and to thereafter diligently complete the same. In the event that Contractor shall fail or refuse to commence correction of any such item within said seven (7) day period or to diligently prosecute such corrective actions to completion, the District may, without further notice to Contractor, cause such corrective Work to be performed and completed. In such event, Contractor and Contractor's Performance Bond Surety shall be responsible for all costs in connection with such corrective Work, including without limitation, general administrative overhead costs of the District in securing and overseeing such corrective Work. Nothing contained herein shall be construed to establish a period of limitation with respect to any obligation of the Contractor under the Contract Documents. The obligations of the Contractor hereunder shall be in addition to, and not in lieu of, any other obligations imposed by any special guarantee or warranty required by the Contract Documents, guarantees or warranties provided by any manufacturer of any item or equipment forming a part of, or incorporated into the Work, or otherwise recognized, prescribed or imposed by law. Neither the District's Final Acceptance, the making of Final Payment, any provision in Contract Documents, nor the use or occupancy of the Work, in whole or in part, by District shall constitute acceptance of Work not in accordance with the Contract Documents nor relieve the Contractor or the Contractor's Performance Bond Surety from liability with respect to any warranties or responsibility for faulty or defective Work or materials, equipment and workmanship incorporated therein.
- 13.3 Guarantee.** Upon completion of the Work, Contractor shall execute and deliver to the District the form of Guarantee included within the Contract Documents. The Contractor's execution and delivery of the form of Guarantee is an express condition precedent to any obligation of the District to disburse the Final Payment to the Contractor.
- 13.4 Survival of Warranties.** The provisions of this Article 13 shall survive the Contractor's completion of Work under the Contract Documents, the District's Final Acceptance or the termination of the Contract.

ARTICLE 14: SUSPENSION OF WORK

- 14.1 District's Right to Suspend Work.** The District may, without cause, and without invalidating or terminating the Contract, order the Contractor, in writing, to suspend, delay or interrupt the Work in whole or in part for such period of time as the District may determine. The Contractor shall resume and complete the Work suspended by the District in accordance with the District's directive, whether issued at the time of the directive suspending the Work or subsequent thereto.
- 14.2 Adjustments to Contract Price and Contract Time.** In the event the District shall order suspension of the Work, an adjustment shall be made to the Contract Price for increases in the direct cost of performance of the Work of the Contract Documents, actually caused by suspension, delay or interruption ordered by the District; provided however that no adjustment of the Contract Price shall be made to the extent: (i) that performance is, was or

would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible under the Contract Documents; or (ii) that an equitable adjustment is made or denied under another provision of the Contract Documents. The foregoing notwithstanding, any such adjustment of the Contract Price shall not include any adjustment to increase the Contractor's overhead, general administrative costs or profit, all of which will remain as reflected in the Cost Breakdown submitted by the Contractor pursuant to the Contract Documents. In the event of the District's suspension of the Work, the Contract Time shall be equitably adjusted.

ARTICLE 15: TERMINATION

15.1 Termination for Cause.

15.1.1 District's Right to Terminate. The District may terminate the Contract upon the occurrence of any one or more of the following events of the Contractor's default: (i) if the Contractor refuses or fails to prosecute the Work with diligence as will insure Substantial Completion of the Work within the Contract Time, or if the Contractor fails to substantially Complete the Work within the Contract Time; (ii) if the Contractor becomes bankrupt or insolvent, or makes a general assignment for the benefit of creditors, or if the Contractor or a third party files a petition to reorganize or for protection under any bankruptcy or similar laws, or if a trustee or receiver is appointed for the Contractor or for any of the Contractor's property on account of the Contractor's insolvency, and the Contractor or its successor in interest does not provide adequate assurance of future performance in accordance with the Contract Documents within 10 days of receipt of a request for such assurance from the District; (iii) if the Contractor repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment; (iv) if the Contractor repeatedly fails to make prompt payments to any Subcontractor, of any tier, or Material Suppliers or others for labor, materials or equipment; (v) if the Contractor disregards laws, ordinances, rules, codes, regulations, orders applicable to the Work or similar requirements of any public entity having jurisdiction over the Work; (vi) if the Contractor disregards proper directives of the Architect, the Project Inspector or District under the Contract Documents; (vii) if the Contractor performs Work which deviates from the Contract Documents and neglects or refuses to correct such Work; or (viii) if the Contractor otherwise violates in any material way any provisions or requirements of the Contract Documents. Once the District determines that sufficient cause exists to justify the action, the District may terminate the Contract without prejudice to any other right or remedy the District may have, after giving the Contractor and the Surety at least seven (7) days advance written notice of the effective date of termination. The District shall have the sole discretion to permit the Contractor to remedy the cause for the termination without waiving the District's right to terminate the Contract, or otherwise waiving, restricting or limiting any other right or remedy of the District under the Contract Documents or at law.

15.1.2 District's Rights Upon Termination. In the event that the Contract is terminated pursuant to this Article 15.1, the District may take over the Work and prosecute it to completion, by contract or otherwise, and may exclude the Contractor from the site. The District may take possession of the Work and of all of the Contractor's tools, appliances, construction equipment, machinery, materials, and plant which may be on the site of the Work, and use the same to the full extent they could be used by the Contractor without liability to the Contractor. In exercising the District's right to prosecute the completion of the Work, the District may also take possession of all materials and equipment stored at the site of the Work or for which the District has paid the Contractor but which are stored

elsewhere, and finish the Work as the District deems expedient. In exercising the District's right to prosecute the completion of the Work, the District shall have the right to exercise its sole discretion as to the manner, methods, and reasonableness of the costs of completing the Work and the District shall not be required to obtain the lowest figure for completion of the Work. In the event that the District takes bids for remedial Work or completion of the Work, the Contractor shall not be eligible for the award of such contract(s).

15.1.3 Completion by the Surety. In the event that the Contract is terminated pursuant to this Article 15.1, the District may demand that the Surety take over and complete the Work. The District may require that in so doing, the Surety not utilize the Contractor in performing and completing the Work. Upon the failure or refusal of the Surety to take over and begin completion of the Work within twenty (20) days after demand therefor, the District may take over the Work and prosecute it to completion as provided for above.

15.1.4 Assignment and Assumption of Subcontracts. The District shall, in its sole and exclusive discretion, have the option of requiring any Subcontractor or Material Supplier to perform in accordance with its Subcontract or Purchase Order with the Contractor and assign the Subcontract or Purchase Order to the District or such other person or entity selected by the District to complete the Work.

15.1.5 Costs of Completion. In the event of termination under this Article 15.1, the Contractor shall not be entitled to receive any further payment of the Contract Price until the Work is completed. If the unpaid balance of the Contract Price as of the date of termination exceeds the District's direct and indirect costs and expenses for completing the Work, including without limitation, attorneys' fees and compensation for additional professional and consultant services, such excess shall be used to pay the Contractor for the cost of the Work performed prior to the effective date of termination with a reasonable allowance for overhead and profit. If the District's costs and expenses to complete the Work exceed the unpaid Contract Price, the Contractor and/or the Surety shall pay the difference to the District.

15.1.6 Contractor Responsibility for Damages. The Contractor and the Surety shall be liable for all damage sustained by the District resulting from, in any manner, the termination of Contract under this Article 15.1, including without limitation, attorneys' fees, and for all costs necessary for repair and completion of the Work over and beyond the Contract Price.

15.1.7 Conversion to Termination for Convenience. In the event the Contract is terminated under this Article 15.1, and it is determined, for any reason, that the Contractor was not in default under the provisions hereof, the termination shall be deemed a Termination for Convenience of the District and thereupon, the rights and obligations of the District and the Contractor shall be determined in accordance with Article 15.2 hereof.

15.1.8 District's Rights Cumulative. In the event the Contract is terminated pursuant to this Article 15.1, the termination shall not affect or limit any rights or remedies of the District against the Contractor or the Surety. The rights and remedies of the District under this Article 15.1 are in addition to, and not in lieu of, any other rights and remedies provided by law or otherwise under the Contract Documents. Any retention or payment of monies to the Contractor by the District shall not be deemed to release the Contractor or the Surety from any liability hereunder.

15.2 Termination for Convenience of the District. The District may at any time, in its sole and exclusive discretion, by written notice to the Contractor, terminate the Contract in whole or in part when it is in the interest of, or for the convenience of, the District. In such case, the Contractor shall be entitled to payment for: (i) Work actually performed and in place as of the effective date of such termination for convenience of the District, with a reasonable allowance for profit and overhead on such Work, and (ii) reasonable termination expenses for reasonable protection of Work in place and suitable storage and protection of materials and equipment delivered to the site of the Work but not yet incorporated into the Work, provided that such payments exclusive of termination expenses shall not exceed the total Contract Price as reduced by payments previously made to the Contractor and as further reduced by the value of the Work as not yet completed. The Contractor shall not be entitled to profit and overhead on Work which was not performed as of the effective date of the termination for convenience of the District. The District may, in its sole discretion, elect to have subcontracts assigned pursuant to Article 15.1.4 above after exercising the right hereunder to terminate for the District's convenience.

ARTICLE 16: MISCELLANEOUS

16.1 Governing Law. This Contract shall be governed by and interpreted in accordance with the laws of the State of California.

16.2 Marginal Headings; Interpretation. The titles of the various Articles of these General Conditions and elsewhere in the Contract Documents are used for convenience of reference only and are not intended to, and shall in no way, enlarge or diminish the rights or obligations of the District or the Contractor and shall have no effect upon the construction or interpretation of the Contract Documents. The Contract Documents shall be construed as a whole in accordance with their fair meaning and not strictly for or against the District or the Contractor.

16.3 Successors and Assigns. Except as otherwise expressly provided in the Contract Documents, all terms, conditions and covenants of the Contract Documents shall be binding upon, and shall inure to the benefit of the District and the Contractor and their respective heirs, representatives, successors-in-interest and assigns.

16.4 Cumulative Rights and Remedies; No Waiver. Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not in lieu of or otherwise a limitation or restriction of duties, obligations, rights and remedies otherwise imposed or available by law. No action or failure to act by the District shall constitute a waiver of a right or remedy afforded it under the Contract Documents or at law nor shall such an action or failure to act constitute approval of or acquiescence in a breach hereunder, except as may be specifically agreed in writing.

16.5 Severability. In the event any provision of the Contract Documents shall be deemed illegal, invalid, unenforceable and/or void, by a court or any other governmental agency of competent jurisdiction, such provision shall be deemed to be severed and deleted from the Contract Documents, but all remaining provisions hereof, shall in all other respects, continue in full force and effect.

16.6 No Assignment by Contractor. The Contractor shall not sublet or assign the Contract, or any portion thereof, or any monies due thereunder, without the express prior written consent and approval of the District, which approval may be withheld in the sole and exclusive discretion of the District. The District's approval to such assignment shall be upon such terms

and conditions as determined by the District in its sole and exclusive discretion.

16.7 Gender and Number. Whenever the context of the Contract Documents so require, the neuter gender shall include the feminine and masculine, the masculine gender shall include the feminine and neuter, the singular number shall include the plural and the plural number shall include the singular.

16.8 Independent Contractor Status. In performing its obligations under the Contract Documents, the Contractor is an independent contractor to the District and not an agent or employee of the District. Nothing contained herein shall be deemed or construed as creating a relationship of employer and employee between the District and the Contractor or any Subcontractors, employees of the Contractor or Subcontractors or their respective agents and representatives. Neither the Contractor, Subcontractors nor any employees of the Contractor or Subcontractors are entitled to any rights or privileges of District employees.

16.9 Notices. Except as otherwise expressly provided for in the Contract Documents, all notices which the District or the Contractor may be required, or may desire, to serve on the other, shall be effective only if delivered by personal delivery or by postage prepaid, First Class Certified Return Receipt Requested United States Mail, addressed to the District or the Contractor at their respective address set forth in the Contract Documents, or such other address(es) as either the District or the Contractor may designate from time to time by written notice to the other in conformity with the provisions hereof. In the event of personal delivery, such notices shall be deemed effective upon delivery, provided that such personal delivery requires a signed receipt by the recipient acknowledging delivery of the same. In the event of mailed notices, such notice shall be deemed effective on the third working day after deposit in the mail.

16.10 Disputes; Continuation of Work. Notwithstanding any claim, dispute or other disagreement between the District and the Contractor regarding performance under the Contract Documents, the scope of Work thereunder, or any other matter arising out of or related to, in any manner, the Contract Documents, the Contractor shall proceed diligently with performance of the Work in accordance with the District's written direction, pending any final determination or decision regarding any such claim, dispute or disagreement.

16.11 Dispute Resolution; Arbitration.

16.11.1 Claims Under \$375,000.00. Claims between the District and the Contractor of \$375,000.00 or less shall be resolved in accordance with the procedures established in Part 3, Chapter 1, Article 1.5 of the California Public Contract Code, §§20104 et seq.; provided however that California Public Contract Code §20104.2(a) shall not supersede the requirements of the Contract Documents with respect to the Contractor's notification to the District of such claim or extend the time for the giving of such notice as provided in the Contract Documents. The term "claims" as used herein shall be as defined in California Public Contract Code §20104(b) (2).

16.11.2 Government Code Claim Requirements. Pursuant to Government Code §930.6, any claim, demand, dispute, disagreement or other matter in controversy asserted by the Contractor against the District for money or damages, including, without limitation, a demand for arbitration, except for those subject to resolution pursuant to Article 16.11.1, shall be deemed a "suit for money or damages" and shall be subject to the provisions of Government Code §§945.4, 945.6 and 946. Notwithstanding the resolution of disputes

pursuant to the arbitration provisions set forth in Article 16.11.3 any claim, demand, dispute, disagreement or other matter in controversy between the Contractor and the District seeking money or damages in excess of \$375,000 shall first be presented to the District and acted upon or deemed rejected by the District in accordance with California Government Code section 900, et seq., as a condition precedent to the Contractor's commencement of arbitration proceedings. Any arbitration proceeding pursuant to Article 16.11.3 commenced by the Contractor without first complying with the foregoing provisions of the Government Code shall be stayed pending the Contractor's compliance with the foregoing provisions of the Government Code.

16.11.3 Arbitration. Except as provided in Article 16.11.1, any other claims, disputes, disagreements or other matters in controversy between the District and the Contractor arising out of, or related, in any manner, to the Contract Documents, or the interpretation, clarification or enforcement thereof shall be resolved by arbitration conducted in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association ("AAA") in effect as of the date that a Demand for Arbitration is filed, except as expressly modified herein. The locale for any arbitration commenced hereunder shall be the regional office of the AAA closest to the Site. The award rendered by the Arbitrator(s) ("Arbitration Award") shall be final and binding upon the District and the Contractor only if the Arbitration Award is supported by law and substantial evidence pursuant to California Code of Civil Procedure §1296, including findings of fact and conclusions of law in conformity with California Code of Civil Procedure §1296 and Rule R-43 of the AAA Construction Industry Arbitration Rules. The District and Contractor hereby expressly agree that the Court shall, subject to California Code of Civil Procedure §§1286.4 and 1296, vacate the Arbitration Award if, after review of the Arbitration Award, the Court determines either that the Arbitration Award is: (i) not supported by substantial evidence; (ii) not accompanied by findings of fact and conclusions of law; or (iii) based on an error of law. In connection with any arbitration proceeding commenced hereunder, the discovery rights and procedures provided for in California Code of Civil Procedure §1283.05 shall be applicable, and the same shall be deemed incorporated herein by this reference. A Demand for Arbitration shall be filed and served within a reasonable time after the occurrence of the claim, dispute or other disagreement giving rise to the Demand for Arbitration, but in no event shall a Demand for Arbitration be filed or served after the date when the institution of legal or equitable proceedings based upon such claim, dispute or other disagreement would be barred by the applicable statute of limitations. In the event more than one Demand for Arbitration is made by either the District or the Contractor, all such controversies shall be consolidated into a single arbitration proceeding, unless otherwise agreed to by the District and the Contractor. The Contractor's Surety, a Subcontractor or Material Supplier to the Contractor and other third parties may be permitted to join in and be bound by an arbitration commenced hereunder if required by the terms of their respective agreements with the Contractor, except to the extent that such joinder would unduly delay or complicate the expeditious resolution of the claim, dispute or other disagreement between the District and the Contractor, in which case an appropriate severance order shall be issued by the Arbitrator(s). The expenses and fees of the Arbitrator(s) shall be divided equally among the parties to the arbitration. Each party to any arbitration commenced hereunder shall be responsible for and shall bear its own attorneys' fees, witness fees and other cost and expense incurred in connection with such arbitration. The foregoing notwithstanding, the Arbitrator(s) may award arbitration costs, including Arbitrators' fees but excluding attorneys' fees, to the prevailing party. The confirmation, enforcement, vacation or correction of an arbitration award rendered hereunder shall be the Superior Court of the State of California for the county in which the

Site is situated. The substantive and procedural rules for such post-award proceedings shall be as set forth in California Code of Civil Procedure §1285 et seq.

- 16.11.4 Inapplicability to Bid Bond.** The provisions of this Article 16.11 shall not be applicable to disputes, disagreements or enforcement of rights or obligations under the Bid Bond; all claims, disputes and actions to enforce rights or obligations under the Bid Bond shall be adjudicated only by judicial proceedings commenced in a court of competent jurisdiction.
- 16.12 Capitalized Terms.** Except as otherwise expressly provided, capitalized terms used in the Contract Documents shall have the meaning and definition for such term as set forth in the Contract Documents.
- 16.13 Attorneys Fees.** Except as expressly provided for in the Contract Documents, or authorized by law, neither the District nor the Contractor shall recover from the other any attorneys fees or other costs associated with or arising out of any legal, administrative or other proceedings filed or instituted in connection with or arising out of the Contract Documents or the performance of either the District or the Contractor thereunder.
- 16.14 Waiver of Special/Consequential Damages.** Notwithstanding any right conferred by law or arising by operation of law, by executing the Agreement, the Contractor expressly waives and relinquishes any and all right or entitlement to assert or recover any damages, losses or liabilities from the District which are in the nature of special or consequential damages, losses or liabilities arising out of or related in any manner to the District's breach or default of its obligations under the Contract Documents.
- 16.15 Provisions Required by Law Deemed Inserted.** Each and every provision of law and clause required by law to be inserted in the Contract Documents is deemed to be inserted herein and the Contract Documents shall be read and enforced as though such provision or clause are included herein, and if through mistake, or otherwise, any such provision or clause is not inserted or if not correctly inserted, then upon application of either party, the Contract Documents shall forthwith be physically amended to make such insertion or correction.
- 16.16 Days.** Unless otherwise expressly stated, references to "days" in the Contract Documents shall be deemed to be calendar days.
- 16.17 Prohibited Interests.** No employee of the District, who is authorized in such capacity on behalf of the District to negotiate, make, accept or approve, or to take part in negotiating, making, accepting or approving any architectural, engineering, inspection, construction or material supply contract or subcontract in connection with the Work shall become directly or indirectly financially interested in the Work or any part thereof.
- 16.18 Entire Agreement.** The Contract Documents contain the entire agreement and understanding between the District and the Contractor concerning the subject matter hereof, and supersedes and replaces all prior negotiations, proposed agreements or amendments, whether written or oral. No amendment or modification to any provision of the Contract Documents shall be effective or enforceable except by an agreement in writing executed by the District and the Contractor.

END OF SECTION

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SPECIAL CONDITIONS

Application of Special Conditions. These Special Conditions are a part of the Contract Documents for the Work generally described as: **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project**

1. Drawings and Specifications The number of sets of the Drawings and Specifications which the District will provide the Contractor, pursuant to Article 2.1.3 of the General Conditions will be mutually agreed upon and reasonable at the District’s discretion and will not exceed 3 sets.

2. Insurance

2.1 Insurance Requirements for Contractor Minimum coverage amounts for each policy of insurance required of the Contractor shall be as follows:

Workers Compensation Insurance	In accordance with applicable law
Employers Liability Insurance	\$1,000,000
Commercial General Liability Insurance (including coverage for bodily injury, death, property damage and motor vehicle liability)	
Per Occurrence	\$2,000,000
Aggregate	\$4,000,000
 Builder’s Risk	 Full value of the Work; seismic coverage is not required

2.2 Insurance Requirements for Subcontractors Minimum coverage amounts for each policy of insurance to be obtained and maintained by each Subcontractor to the Contractor shall be as follows:

Workers Compensation Insurance	In accordance with applicable law
Employers Liability Insurance	\$1,000,000
Commercial General Liability Insurance (including coverage for bodily injury, death, property damage and motor vehicle liability)	
Per Occurrence	\$1,000,000
Aggregate	\$2,000,000

3. Contract Time, Liquidated Damages

3.1 Contract Time The Contract Time for the Contractor’s Substantial Completion of the Work is **Four Hundred (400) Calendar days** after the date for commencement of the Work as set forth in the Notice to Proceed issued by or on behalf of the District to the Contractor. The anticipated Notice to Proceed date of May 11, 2021.

3.1.1 Pre-Construction Conference: A pre-construction conference with the Unions and with representatives of all involved Contractors/Employers, who shall be prepared to announce craft assignments and to discuss in detail the scope of work and the other issues set forth below, at least twenty-one (21) calendar days prior to: (a) The commencement of any Project work, and (b) The

commencement of Project work on each subsequently awarded Construction Contract, as set forth in the Project Labor Agreement.

- 3.1.2** Contractor's bid is to include all necessary PPE containments and environmental controls needed to perform scope of work in compliance with State, County, City, and CLPCCD Mandates. Masks are required at all times while on District Property.

3.2 Liquidated Damages

- 3.2.1** Delayed Submission of Preliminary Construction Schedule: If the Contractor fails to submit the Contractor's Preliminary Construction Schedule within the time established in the General Conditions, the Contractor shall be subject to assessment of Liquidated Damages in the amount of **One Thousand Dollars (\$1,000.00)** per day from the date the Preliminary Construction Schedule is required to be submitted until submission thereof to the District.
- 3.2.2** Delayed Substantial Completion: If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, including adjustments thereto in accordance with the Contract Documents, the Contractor shall be subject to assessment of Liquidated Damages in the amount of **One Thousand Five Hundred Dollars (\$1,500.00)** per day from the scheduled date of Substantial Completion until Substantial Completion is achieved.
- 3.2.3** Delayed Task Substantial Completion: If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, including adjustments thereto in accordance with the Contract Documents, the Contractor shall be subject to assessment of Liquidated Damages in the amount of **One Thousand Five Hundred Dollars (\$1,500.00)** per day from the scheduled date of Substantial Completion until Substantial Completion is achieved.
- 3.2.4** Delayed Completion of Punchlist Items: If the Contractor fails to complete all Punchlist Items noted upon Substantial Completion within the time established for completion of all Punchlist Items, the Contractor shall be subject to assessment of Liquidated Damages in the amount of **One Thousand Dollars (\$1,000.00)** per day from the scheduled date of completion until all Punchlist Items are completed.
- 3.2.5** District Withhold of Liquidated Damages; Performance Bond Surety: If the Contractor is subject to assessment of Liquidated Damages for delayed Substantial Completion and/or delay completion of Punchlist Items, the District may withhold such assessments from the Contract Price then or thereafter due the Contractor. If the assessment of Liquidated Damages exceeds the then remaining balance of the Contract Price, the Contractor and the Surety issuing the Performance Bond shall be jointly and severally liable to the District for such amounts.

- 3.3** Delays due to Unanticipated, Unusually Severe Weather Conditions: Delays due to adverse weather conditions will only be granted to the extent they exceed the "normal" anticipated Inclement Weather Days set forth herein. A weather delay day shall be granted for each calendar day the Contractor can document adverse weather caused critical path delays in excess of 34 calendar days. This is the number to be used in the schedules under the activity entitled "Remaining Inclement Weather Days". See General Conditions Paragraph 7.3.9 for further information and notice requirements documenting "Inclement Weather Days".

Weather Days Per Month					
January:	6	May:	1	September:	0
February:	6	June:	1	October:	1
March:	6	July:	0	November:	4
April:	3	August:	0	December:	6

3.4 Notice of Delay: The Contractor shall notify the Construction Manager, in writing, of all delays Pursuant to Articles 7 and 9 of the General Conditions.

4. **District Provided Temporary Utilities** Pursuant to Article 4.3.4 of the General Conditions, during the Contractor’s performance of the Work, the District will provide utility services and a point of connection for electrical power and domestic potable water. The connection and placement, relocation and removal of temporary distributions of the electrical power and domestic potable water utility service provided by the District will be by the Contractor at its cost and expense without adjustment of the Contract Price. The Contractor may use the temporary electrical power and domestic potable water service furnished by the District provided that: (a) the District may discontinue, limit or condition use of such services by a Contractor if the District reasonably determines that the Contractor has wasted such utilities, and (b) the District shall not be liable to the Contractor, nor shall the Contract Time or the Contract Price be increased if any District provided temporary utility service is discontinued or disrupted for any reason other than the District’s non-payment of undisputed utility charges.

5. **Project Inspector Field Office** Contractor to provide a field office at least 10 ft. x 10ft., insulated, weathertight, air-conditioned for the Inspector of Record. The trailer is to be equipped with security bars on all exterior windows and doors. Provide three (3) sets of keys for each door. Contractor to provide and install exterior lights on the trailer. The contractor shall furnish the Project Inspector’s office with: operable window shades, one (1) office desk, one (1) ergonomic chair, two (2) guest chairs, one (1) four-drawer metal file cabinet, one (1) plan table, one (1) bookcase, one (1) dry-erase whiteboard, water cooler/drinking water dispenser, color multi-function copy/prINTER/scan machine accommodating letter, legal and ledger-size paper with wireless capabilities, first aid kit and fire extinguisher. The contractor shall pay all costs associated with copies and supplies to the color multi-function printer. The contractor to provide high-speed internet service, modem, and four-port wireless router for networking hardware/software for use during construction for the Project Inspector trailer. Contractor shall provide weekly professional cleaning service for the trailer.

6. **Mark-Ups on Changes to the Work** In the event of Changes to the Work, pursuant to Article 9 of the General Conditions, the mark-up for all overhead (including home and field office overhead), general conditions costs and profit, shall not exceed the percentage of allowable direct actual costs for performance of the Change as set forth below. For the portion of any Change performed by Subcontractors of any tier, the percentage mark-up on allowable actual direct labor and materials costs incurred by all Subcontractors of any tier shall be Twelve Percent (12%). In addition, for the portion of any Change performed by a Subcontractor of any tier, the Contractor may add an amount equal to Five Percent (5%) of the allowable actual direct labor and materials costs of Subcontractors performing the Change. For the portion of any Change performed by the Contractor’s own forces, the mark-up on the allowable actual direct labor and materials costs of such portion of a Change shall be Fifteen Percent (15%).

7. **Form and Content of Change Orders** In accordance with the provisions of Article 9.5 of the General Conditions, if the District approves of a Change Order, the Change Order issued by the District and executed by the District, Architect, Construction Manager and Contractor shall be in the form and content as set forth in Attachment A to these Special Conditions.
8. **Asbestos and Other Hazardous Materials Certification** Upon completion of the Work and as an additional express condition precedent to the District's obligation to disburse the Final Payment to the Contractor, the Contractor's duly authorized representative shall deliver to the District the completed and executed form of Asbestos and Other Hazardous Materials Certification included as Attachment B to the Special Conditions; the signature of the Contractor's representative shall be notarized by a California Notary Public.
9. **Debris Recycling Statement** The District's form of Debris Recycling Statement is attached to these Special Conditions as Attachment C. The Contractor shall complete, execute and submit the Debris Recycling Statement in accordance with applicable provisions of the Contract Documents, under General Conditions, Supervision and Construction Procedures, Section 4.3.9.
10. **Public Works Contractor Registration Certificate.** The District's form of Public Works Contractor Registration Certification form is attached to these Special Conditions as Attachment D. The Contractor and its Sub-Contractors shall complete, execute and submit the Public Works Contractor Registration Certification form with the Bid Proposal in accordance with the Bid Documents.
11. **Additional Definitions** In addition to terms defined elsewhere in the Contract Documents, the following terms used in the Contract Documents are defined as set forth herein.
 - 11.1 **Owner** Unless otherwise expressly provided, references to the "Owner" shall be deemed references to the District, as that term is defined in the Contract Documents.
 - 11.2 **Inspector; Inspector of Record; IOR; Owner's Inspector** Unless otherwise expressly provided, references to Inspector, Inspector of Record, IOR or Owner's Inspector shall be deemed references to the Project Inspector as that term is defined in the Contract Documents.
 - 11.3 **Contract Sum** Unless otherwise expressly provided, the terms "Contract Price" and "Contract Sum" are synonymous.
 - 11.4 **Campus** Unless otherwise expressly provided, the term "Campus" shall be deemed to refer to the District's Chabot College campus.
 - 11.5 **Rain Days**. Pursuant to Article 7.3.9 of the General Conditions, the rain days included within the contract period shall be thirty-four (34) calendar days.

**CHANGE ORDER FORM
(ATTACHMENT A TO SPECIAL CONDITIONS)**

Project: _____
Date: _____

Change Order#: _____

Contractor: _____

Pursuant to the General Conditions, this Change Order Form shall be used for all Change Orders associated with the Work. No additions or deletions to this form shall be allowed, except with permission of the District.

You are hereby directed to provide the extra work necessary to comply with this Change Order.

DESCRIPTION OF CHANGE:

Contractor accepts the terms and conditions stated as full and final settlement of any and all claims arising from this Change Order. Contractor agrees to perform the above described changes in accordance with the terms set forth herein and in compliance with applicable sections of the Contract Documents. This Change Order is hereby agreed to, accepted and approved, all in accordance with the General Conditions of the Contract Documents. The adjustment of the Contract Price and the Contract Time for the changes noted in this Change Order (the "Changes") represents the full and complete adjustment of the Contract Time and the Contract Price due the Contractor for providing and completing such Changes, including without limitation: (i) all costs (whether direct or indirect) for labor, equipment, materials, tools, supplies and/or services; (ii) all general and administrative overhead costs (including without limitation, home office, field office and Site general conditions costs) and profit; and (iii) all impacts, delays, disruptions, interferences, or hindrances in providing and completing the Changes. Contractor waives all rights, including without limitation those arising under Civil Code Section 1542, for any other adjustment of the Contract Price or the Contract Time on account of the Changes set forth in this Change Order or the Contractor's performance and completion of the Changes.

NOT VALID UNTIL SIGNED BY THE OWNER, ARCHITECT, AND CONTRACTOR

The original Contract Sum was \$ _____

Net change by previously authorized Change Orders \$ _____

The Contract Sum prior to this Change Order was \$ _____

The Contract Sum will be changed by this Change Order in the amount of \$ _____

The adjusted Contract Sum including this Change Order will be \$ _____

The Contract Time will be (increased) (decreased) (unchanged) by (_____) Days

The Contractual date of Substantial Completion as of the date of this Change Order therefore is: . . . ____/____/____

ARCHITECT	CONTRACTOR	CONSTRUCTION MANAGER
By: _____	By: _____	By: _____
Date: _____	Date: _____	Date: _____

Vice Chancellor Fac/Bond

OWNER
CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT
7600 Dublin Blvd., 3rd Floor, Dublin, CA 94568

By: _____ Date: _____

By: _____ Date: _____

**ASBESTOS AND OTHER HAZARDOUS MATERIALS CERTIFICATION
(ATTACHMENT B TO SPECIAL CONDITIONS)**

This Asbestos and Other Hazardous Materials Certification form is part of the Contract made by and between the CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT and **BID NO.: B20/21-08, Agriculture Science, Horticulture Facility Project** (hereinafter referred to as the "Project").

To the best of my knowledge, information and belief, in completing the Work of the Project, no materials, equipment or other items furnished, installed or incorporated into the Project contains, or in itself be composed of, any asbestos, polychlorinated biphenyl (PCB), any material listed by the federal or state EPA or federal or state health agencies as a hazardous material, or defined as being hazardous under federal or state laws, rules or regulations.

The undersigned is duly authorized to complete, execute and submit this Asbestos and Other Hazardous Materials Certification on behalf of the Contractor. The undersigned has personal knowledge of the substantive representations set forth hereinabove or has made appropriate diligent inquiry to ascertain that the substantive representations set forth hereinabove are complete, true and accurate and do not omit material facts rendering such representations to be false or misleading.

_____ ("Contractor") for the work of improvement commonly referred to as I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed on this _____ day of _____, 2021 at _____.
(City and State)

Name of Contractor (Print or Type)

By: _____
Signature

Print Name

Title

Subscribed and sworn before me
this ____ day of _____, 2021

Notary Public in and for the State of California

My Commission Expires:

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Chabot – Las Positas Community College District
Construction & Demolition
DEBRIS RECYCLING STATEMENT
(Attachment C to Special Conditions)

Project Name / Location: _____			
_____ Demolition	_____ Construction		
Contractor Name: _____			
Contact Name: _____	Phone: _____	Fax: _____	
Anticipated Start Date: _____	Anticipated Completion Date: _____		
Statement Date: _____			
For the period between: _____ / _____ and _____ / _____			
Month	Year	Month	Year

Please indicate estimated quantities by matter, the proposed processing method and the vendor selected. Weight tag required as verification.

	Estimated Amount (Tons or Yards)			
	Recycled	Salvaged	Landfilled	
Asphalt				
Concrete				
Brick/Masonry Tile				
Corrugated Cardboard				
Dirt/Clean Full				
Drywall				
Padding – Carpet Foam				
Building Materials (doors, windows, cabinets, fixtures)				
Scrap Metals				
Mixed Recyclable Debris				
Other				
Un-painted wood/Pallets				
Green Waste/Yard Waste				
Garbage – Painted Wood- Trash				

If no materials are targeted for recycling, reuse or salvage, please state why: _____

The undersigned certifies that she/he is authorized to execute this Debris Recycling Statement on behalf of the above-identified Contractor. The undersigned further certifies that she/he has personal knowledge of the foregoing, or has made reasonable inquiry to ascertain, that the foregoing is true, complete and correct.

Submitted by: _____ Date: _____

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PUBLIC WORKS CONTRACTOR REGISTRATION CERTIFICATION
(Attachment D to Special Conditions)

I, _____, am the _____ of
(Print Name) (Title)

(Contractor Name)

I declare, state and certify to all of the following:

1. I am aware of the provisions and requirements of California Senate Bill (SB) 854, the Public Works Contractor Registration Program.
2. I am authorized to certify, and do certify, on behalf of Contractor that an annual registration fee has been paid and I am registered as eligible to bid and work on public works projects by doing all of the following:
 - A. Must have workers' compensation coverage for any employees and only use subcontractors who are glistered public works contractors;
 - B. Must have Contractors State License Board license, if applicable to trade;
 - C. Must have no delinquent unpaid wage or penalty assessments owed to any employee or enforcement agency;
 - D. Must not be under federal or state debarment;
 - E. Must not be in prior violation of this registration requirement once it becomes effective on April 1, 2015.
3. Contractor and I understand that if the District determines that Contractor has either: (a) made a false certification herein, or (b) violated this certification by failing to carry out and to implement the requirements of the Department of Industrial Relations (DIR), the Contract awarded herein is subject to termination, suspension of payments, or both. Contractor and I further understand that, should Contractor violate the terms of the Public Works Contractor Registration Certification Law of California Senate Bill 854, Contractor may be subject to debarment in accordance with the provisions of California Labor Code §§1720, et seq.
4. Contractor and I acknowledge that Contractor and I are aware of the provisions of California Senate Bill 854 and hereby certify that Contractor and I will adhere to, fulfill, satisfy and discharge all provisions of and obligations under the Public Works Contractor Registration Program.

I declare under penalty of perjury under the laws of the State of California that all of the foregoing is true and correct.

Executed at _____ this _____ day of
(City and State)

_____, 2021

(Signature)

(Handwritten or Typed Name)

Department of Industrial Relations Registration #

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Escrow Agreement for Security Deposits in Lieu of Retention
P.C.C. §22300

THIS ESCROW AGREEMENT ("Escrow Agreement") is made and entered into this _____ day of _____, 202[], by and between the CHABOT LAS POSITAS COMMUNITY COLLEGE DISTRICT (hereinafter called the "District"), whose address is 7600 Dublin Boulevard, Dublin, California 95554; _____ ("Contractor"), whose place of business is located at _____; and [District, as escrow agent ...OR... []], a state or federally chartered bank in the State of California, whose place of business is located at _____] ("Escrow Agent").

For the consideration hereinafter set forth, District, Contractor and Escrow Agent agree as follows:

1. Pursuant to Section 22300 of Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by District pursuant to Contract Number [] entered into between District and Contractor for District-wide Emergency Call Station Project in the amount of [] dated [] (the "Contract"). Alternatively, on written request of Contractor, District shall make payments of the retention earnings directly to Escrow Agent. When Contractor deposits the securities as a substitute for Contract earnings, Escrow Agent shall notify District within ten (10) Days of the deposit. The market value of the securities at the time of substitution shall be at least equal to the cash amount then required to be withheld as retention under terms of Contract between District and Contractor. Securities shall be held in name of _____, and shall designate Contractor as the beneficial owner.
2. District shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to Contract provisions, provided that Escrow Agent holds securities in form and amount specified in paragraph 1 of this Section 00680.
3. When District makes payment(s) of retention earned directly to Escrow Agent, Escrow Agent shall hold said payment(s) for the benefit of Contractor until the time that the escrow created under this Escrow Agreement is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Escrow Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when District pays Escrow Agent directly.
4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account, and all expenses of District. Such expenses and payment terms shall be determined by District, Contractor, and Escrow Agent.
5. Interest earned on securities or money market accounts held in escrow and all interest earned on that interest shall be for sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to District.
6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from District to Escrow Agent that District consents to withdrawal of amount sought to be withdrawn by Contractor.
7. District shall have the right to draw upon the securities in event of default by Contractor. Upon

seven (7) Days written notice to Escrow Agent from District of the default, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by District.

8. Upon receipt of written notification from District certifying that the Contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on written notifications from District and Contractor pursuant to paragraphs 5 through 8, inclusive, of this Section 00680 and District and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of securities and interest as set forth.
10. Names of persons who are authorized to give written notice or to receive written notice on behalf of District and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of Escrow Agent:

Title

Name

Signature

Address

City/State/Zip

At the time the Escrow Account is opened, District and Contractor shall deliver to Escrow Agent a fully executed counterpart of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Escrow Agreement by their proper officers on the date first set forth above.

District:

Contractor:

Vice Chancellor _____

Title

Title

Name

Name

Signature

Signature

7600 Dublin Boulevard

Address

Address

Dublin, California 95554

City/State/Zip

City/State/Zip

Escrow Agent:

Title

Name

Signature

Address

City/State/Zip

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GUARANTEE

District: CHABOT-LAS POSITAS COMMUNITY COLLEGE DISTRICT
Project: BID NO.: 20/21-08 Agriculture Science, Horticulture Facility Project

Contractor Name: _____

The Contractor hereby warrants and guarantees to the District that all work, materials, equipment and workmanship provided, furnished or installed by or on behalf of Contractor in connection with the above-referenced Project (the "Work") have been provided, furnished and installed in strict conformity with the Contract Documents for the Work, including without limitation, the Drawings and the Specifications. Contractor further warrants and guarantees that all work, materials, equipment and workmanship as provided, furnished and/or installed are fit for use as specified and fulfill all applicable requirements of the Contract Documents including without limitation, the Drawings and the Specifications. Contractor shall, at its sole cost and expense, repair, correct and/or replace any or all of the work, materials, equipment and/or workmanship of the Work, together with any other items which may be affected by any such repairs, corrections or replacement, that may be unfit for use as specified or defective within a period of one (1) year from the date of the District's Final Acceptance of the Work, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of the Contractor's failure and/or refusal to comply with the provisions of this Guarantee, within the period of time set forth in the Contract Documents after the District's issuance of the Notice to the Contractor of any defect(s) in the Work, materials, equipment or workmanship, Contractor authorizes the District, without further notice to Contractor, to repair, correct and/or replace any such defective item at the expense of the Contractor. The Contractor shall reimburse the District for all costs, expenses or fees incurred by the District in providing or performing such repairs, corrections or replacements within ten (10) days of the District's presentation of a demand to the Contractor for the same.

The provisions of this Guarantee and the provisions of the Contract Documents for the Work relating to the Contractor's Guarantee(s) and warranty(ies) relating to the Work shall be binding upon the Contractor's Performance Bond Surety and all successors or assigns of Contractor and/or Contractor's Performance Bond Surety.

The provisions of this Guarantee are in addition to, and not in lieu of, any provisions of the Contract Documents for the Work relating to the Contractor's guarantee(s) and warranty(ies) or any guarantee(s) or warranty(ies) provided by any material supplier or manufacturer of any equipment, materials or other items forming a part of, or incorporated into the Work, or any other guarantee or warranty obligation of the Contractor, prescribed, implied or imposed by law.

The undersigned individual executing this Guarantee on behalf of Contractor warrants and represents that he/she is duly authorized to execute this Guarantee on behalf of Contractor and to bind Contractor to each and every provision hereof.

Dated: _____

By: _____
(Signature)

(Typewritten or handwritten name)

(Title)

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**CHABOT
LAS POSITAS**

COMMUNITY
COLLEGE
DISTRICT

**PROJECT SPECIFICATIONS
CHABOT LAS POSITAS COMMUNITY COLLEGE
AGRICULTURE SCIENCE
HORTICULTURE FACILITY**

**Las Positas Community College
3000 Campus Hill Drive
Livermore, CA 94551
925-424-1000**

ATI Project No. C9508



[innovative ENGAGING architecture]
MINDS

ATI Architects + Engineers
4750 Willow Road, #250
Pleasanton, CA 94588
925-648-8800

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SEALS PAGE

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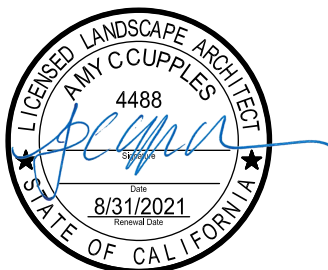
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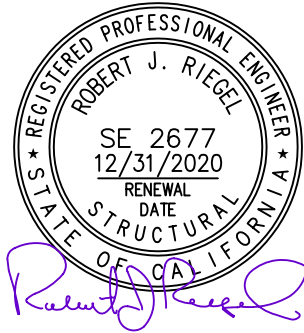
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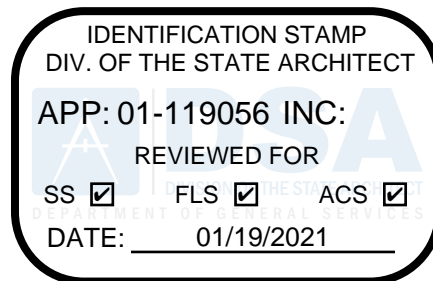


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END OF SECTION



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SECTION 01 1100
SUMMARY OF WORK

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes summary of work including:
1. Work covered by Contract Documents
 2. Bid items, Allowances and Alternates
 3. Work under other contracts
 4. Future work
 5. Work sequence
 6. Cooperation of contractor and coordination with other work
 7. Maintenance
 8. Occupancy requirements
 9. Reference Standards
 10. Products ordered in advance
 11. CLPCCD furnished products

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Approximately two (2) acres on the Northeast corner of the Las Positas College Campus has been allocated for a new Horticulture Facility. Located east of the existing maintenance and operations buildings off of the existing round-about, the new facility will have a classroom building with office/resource library and lactation room within, a greenhouse, a shade house, a covered outdoor learning patio, outdoor student project areas, orchards, growing grounds, equipment storage with adjacent carport, soil bins, and a parking lot that can accommodate thirty (30) stalls including two (2) accessible parking spaces. The project is targeted for LEED NC v4.2 Silver Certification. The scope of work includes construction of said structures above, site demolition, site paving, site grading, construction of site elements. Documents will note extent of demolition.
- B. The work shall include all work shown and specified except for work indicated “N.I.C” or “Not in Contract”.
- C. The Contractor must maintain access to nearby existing buildings at all times during the project. The contractor is to provide secure fencing and/or barricades to keep the general public from entering work area.
- D. Unless provided otherwise in the Contract Documents, all risk of loss of Work covered by the Contract Documents shall rest with the Contractor until Final Completion and Acceptance of the Work.

1.3 BID ITEMS

- A. Base Bid- Furnish and install all work shown on Drawings and described in Specifications and all other Contract Documents
- B. Allowance-An Owner’s unspecified allowance is as noted in Paragraph 1.1 of the Bid Proposal.

1.4 WORK UNDER OTHER CONTRACTS

Not Applicable

1.5 FUTURE WORK

Not Applicable.

1.6 WORK SEQUENCE

A. The contractor shall coordinate their work with the Construction Manager.

1.7 COOPERATION OF CONTRACTOR AND COORDINATION WITH OTHER WORK.

A. Should construction work, or work of any other nature, be underway by other forces or by other contractors within or adjacent to the limits of the Work at the time the Work was advertised for bids, the Contractor shall cooperate with all such other contractors or forces to the end that any delay or hindrance to their work will be avoided. The cost of such cooperation will be considered as included in the prices bid and no direct or additional payment will be made therefore. Contractor shall coordinate with such other contractors and forces as required by General Conditions.

B. CLPCCD reserves the right to perform other or additional work, within or adjacent to the limits of the work specified, at any time by the use of other forces. Contractor shall coordinate with CLPCCD and any CLPCCD forces, or other forces, engaged by CLPCCD, as required by General Conditions. In the event that the performance of such other or additional work materially increases or decreases Contractor's costs, the work and the amount to be paid therefore will be appropriately adjusted as determined by the Construction Manager.

C. Limit use of the Site for Work and for construction operations to allow for:

1. CLPCCD operation
2. Work by other contractors and tenants

D. Coordinate use of the Site and access to site with other contractors, utilities, and CLPCCD forces, as required by General Conditions. Construction Manager has final authority over coordination, use of the Site, and access to site.

E. Cooperate with CLPCCD and others who may occupy and begin work on site and inside building prior to completion of Work of this Contract.

F. Cooperate with contractors for other area work, not included in Contract, but which may take place during construction period.

1.8 MAINTENANCE

A. Cost of maintenance of systems and equipment prior to Final Acceptance will be considered as included in prices bid and no direct or additional payment will be made therefore.

1.9 OCCUPANCY REQUIREMENTS

A. Whenever, in the opinion of Construction Manager, Work or any part thereof is in a condition suitable for use, and the best interest of CLPCCD requires such use, CLPCCD may take beneficial occupancy of and connect to, open for public use, or use the Work or such part thereof. In such case, CLPCCD will request Architect/Engineer to inspect the Work or part thereof, and issue a Certificate of Substantial Completion for that part of Work.

B. Prior to date of Final Acceptance of the Work by CLPCCD, all necessary repairs or renewals in Work or part thereof so used, not due to ordinary wear and tear, but due to defective materials or workmanship or to operations of Contractor, shall be made at expense of Contractor, as required in General Conditions.

- C. Use by CLPCCD of Work or part thereof as contemplated by this section shall in no case be construed as constituting acceptance of Work or any part thereof. Such use shall neither relieve Contractor of any responsibilities under Contract, nor act as waiver by CLPCCD of any of the conditions thereof.
- D. CLPCCD may specify in the Contract Documents that portions of the Work, including electrical and mechanical systems or separate structures, shall be substantially completed on milestone dates prior to substantial completion of all of the Work. Contractor shall notify Architect/Engineer in writing when Contractor considers any such part of the Work ready for its intended use and substantially complete and request Architect/Engineer to issue a Certificate of Substantial Completion for that part of the Work.

PART 2 – PRODUCTS

2.1 REFERENCE STANDARDS

- A. For products specified by association or trade standards, comply with requirements of standard, except where more rigid requirements are specified or are required by applicable codes.

2.2 PRODUCTS ORDERED IN ADVANCE

Not applicable.

2.3 CLPCCD FURNISHED PRODUCTS

For CLPCCD furnished products as specified, if any, shall be indicated on Construction Documents.

PART 3 – EXECUTION

Not applicable.

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SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

- A. This section describes general procedural requirements for alterations, modifications and extras.
- B. Related Sections
 - 1. Section 01 11 00: Summary of Work

1.2 GENERAL

- A. Any change in scope of work or deviation from Drawings or Specifications shall be accomplished only when authorized in writing by Construction Manager. As appropriate, change orders are subject to approval by the Division of the State Architect. Refer to section 4-338, Part 1, Title 24, California Code of Regulations.
- B. Changes in scope of Work or deviation from Drawings or Specifications may be initiated only by the Contractor or the Construction Manager.
 - 1. Contractor may initiate changes by submitting Requests for Information (RFI), Requests for Substitution (RFS), Notice of Concealed or Unknown Conditions, or Notice of Hazardous Waste Conditions.
 - a. RFI's shall be submitted to seek clarification of Contract Documents.
 - b. RFS's shall be submitted in accordance with paragraph 4.8.2 of General Conditions to request substitution of materials or methods of execution.
 - c. Notices of Changes shall be submitted in accordance with paragraph 9.6 of General Conditions.
 - d. Notices of Hazardous Waste Conditions shall be submitted in accordance with paragraph 4.17 of General Conditions.
 - e. Notices of concealed or unknown conditions shall be submitted to make Owner aware of a potential change in scope of the work.
 - 2. Contractor shall be responsible for its costs to implement and administer RFI's and RFS's throughout the Contract duration. Regardless of the number of RFI's submitted, Contractor will not be entitled to additional compensation. Contractor shall be responsible for both CLPCCD's and Architect's administrative costs for answering its RFI's where the answer could reasonably be found by reviewing the Contract Documents, as determined by CLPCCD; such costs will be deducted from progress payments.
 - 3. Architect/Engineer may initiate changes by issuing a Supplemental Instruction (which shall require written approval of the Construction Manager).
 - 4. Construction Manager may initiate changes by issuing Requests for Proposal (RFP) or a Field Change Notice (FCN) to Contractor. Such RFP's or FCN's will detail all proposed changes in the Work and request a quotation of changes in Contract Sum and Contract Times from Contractor. A RFP or FCN may require Contractor to expedite the work and proceed on a time and material (force account) basis.

1.3 PROCEDURE

- A. Contractor shall submit RFI to Construction manager. Contractor shall reference each RFI to an activity on its Progress Schedule and note the time criticality of the RFI, indicating the time in which the response is required. Architect/Engineer shall respond by issuing a Clarification.
 - 1. If Contractor is satisfied with the Clarification and does not request change in Contract Sum or Contract Times, then the Clarification shall be executed without a change.

2. If Contractor believes that the Clarification results in change in Contract Sum or Contract Times, Contractor shall notify Construction Manager who may then deny request for change or issue RFP.
- B. Contractor shall submit RFS to Construction Manager who may then deny request or issue RFP.
- C. Contractor shall submit Notices of Changes to resolve unanticipated conditions incurred in the execution of the Work. Procedures in Paragraph 9.6 of General Conditions shall be followed. If Construction Manager determines that a change in Contract Sum or contract Times is justified, Construction Manager shall issue RFP.
- D. Contractor shall submit Notices of Hazardous Waste Conditions to resolve problems regarding hazardous materials encountered in the execution of the Work. Procedures in Paragraph 4.17 of General Conditions shall be followed. If Construction Manager determines that a change in Contract Sum or contract Times is justified, Construction Manager shall issue RFP.
- E. Architect/Engineer shall issue Supplemental Instruction to the Construction Manager who shall forward onto Contractor. Contractor shall not proceed with Supplemental Instruction until Construction Manager approves it in writing.
 1. If Contractor is satisfied with Supplemental Instruction and does not request change in Contract Sum or Contract Times, then Supplemental Instruction shall be executed without a Change Order.
 2. If Contractor believes that Supplemental Instruction results in change in Contract Sum or Contract Times, Contractor shall notify Construction Manager. Construction Manager may then deny request for change, cancel Clarification or issue RFP.
- F. Responses by recipients shall be within a reasonable time.
- G. Contractor shall respond to Construction Manager's RFP within fifteen (15) working days by furnishing a complete breakdown of costs of both credits and extras; itemizing materials, labor, taxes, overhead and profit. Subcontract work shall be so indicated.
- H. Upon approval of RFP, Construction Manager will issue a Change Order directing Contractor to proceed with extra work.
- I. Payment shall be made as follows:
 1. Change Orders which increase Contract Sum or Contract Times shall be included in next Contract Modification Form, signed by Construction Manager, accepted by Contractor.
 2. Payment shall be made for Change Order work along with other work in progress payment following completion of Change Order work. Partial completion of Change Order work shall be paid for that part completed during the period covered by the monthly payment request.

1.4 COST DETERMINATION

- A. Total cost of extra work shall be the sum of labor costs, material costs, equipment rental costs and specialist costs as defined herein plus overhead and profit as allowed herein. This limit applies in all cases of claims for extra work, whether calculating Change Orders, RFIs, or calculating claims of all types, and applies even in the event of fault, negligence, strict liability, or tort claims of all kinds, including misrepresentation, concealment, strict liability or negligence. No other costs arising out of or connected with the performance of extra work, of any nature, may be recovered by Contractor. No special, incidental or consequential damages may be claimed or recovered against CLPCCD, its representatives or agents, whether arising from breach of contract, negligence or strict liability, unless specifically authorized in the Contract Documents.
- B. Overhead:
 1. Overhead shall be as defined in Article 1.08.

- C. Taxes:
 - 1. Alameda County Sales Tax should be included.
 - 2. Federal and Excise Tax shall not be included.
- D. Owner Operated Equipment
When owner-operated equipment is used to perform extra work, Contractor will be paid for equipment and operator as follows:
 - 1. Payment for equipment will be made in accordance with Paragraph 1.05. C.
 - 2. Payment for cost of labor will be made at no more than rates of such labor established by collective bargaining agreements for type of worker and location of work, whether or not owner-operator is actually covered by such an agreement.

1.5 COST BREAKDOWN

- A. Labor - Contractor will be paid cost of labor for workers (including fore persons when authorized by Construction Manager) used in actual and direct performance of extra work. Labor rate, whether employer is Contractor, subcontractor or other forces, will be sum of following:
 - 1. Actual Wages - Actual wages paid shall be limited to the applicable prevailing wage rate for the classification of labor actually and reasonably necessary to complete a Change. Prevailing wage rates shall be deemed to include all direct payment of wages to workers completing a Change and all employer burdens thereon, including without limitation all employer payments to or on behalf of workers for Workers Compensation, health and welfare, pension, vacation and other similar labor burdens. Contractors and subcontractors are required to provide their corresponding wage rate breakdown for the classification of labor under which they will complete a Change and on the form provided by the Owner for review and approval by the Owner and Construction Manager prior to processing and approval of payment for any completed Change.
- B. Material - Only materials furnished by Contractor and necessarily used in performance of extra work will be paid for. Cost of such materials will be cost, including sales tax, to purchaser (Contractor, subcontractor or other forces) from supplier thereof, except, as the following are applicable:
 - 1. If cash or trade discount by actual supplier is offered or available to purchaser, it shall be credited to CLPCCD notwithstanding fact that such discount may not have been taken.
 - 2. For materials salvaged upon completion of extra work, salvage value of materials shall be deducted from cost, less discount, of materials.
 - 3. If cost of a material is, in opinion of Construction Manager, excessive, then cost of material shall be deemed to be lowest current wholesale price at which material is available in quantities concerned delivered to Site, less any discounts as provided in subparagraph 1 above.
- C. Equipment Rental - For Contractor or subcontractor-owned equipment, payment will be made at the lesser of actual rental rates or the rental rates listed for equipment in California Department of Transportation official equipment rental rate schedule which is in effect on date upon which extra work is accomplished and which schedule is incorporated herein by reference as though fully set forth herein. For rented equipment, payment will be made based on actual rental invoices. Equipment used on extra work shall be of proper size and type. If, however, equipment of unwarranted size or type and cost is used, cost of use of equipment shall be calculated at rental rate for equipment of proper size and type. Rental rates paid shall be deemed to cover cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, and all incidentals. Unless otherwise specified, manufacturer's ratings, and manufacturer-approved modifications, shall be used to classify equipment for determination of applicable rental rates. Individual pieces of equipment or tools not listed in said publication and having a replacement value of five hundred dollars (\$500) or less, whether or not consumed by use, shall be

considered to be small tools and no payment will be made therefore as payment is included in payment for labor. Rental time will not be allowed while equipment is inoperative due to breakdowns.

1. For equipment on Site, rental time to be paid for equipment shall be the time equipment is in operation on extra work being performed. The following shall be used in computing rental time of equipment:
 - a. When hourly rates are listed, less than thirty (30) minutes of operation shall be considered to be one-half (1/2) hour of operation.
 - b. When daily rates are listed, less than four (4) hours of operation shall be considered to be one-half (1/2) day of operation. Anything over four (4) hours and not more than eight (8) hours is considered one (1) full day of operation.
 2. For equipment, which must be brought to Site to be used exclusively on extra work, cost of transporting equipment to Site and its return to its original location shall be determined as follows:
 - a. CLPCCD will pay for costs of loading and unloading equipment.
 - b. Cost of transporting equipment in low bed trailers shall not exceed hourly rates charged by established haulers.
 - c. Cost of transporting equipment shall not exceed applicable minimum established rates of California Public Utilities Commission.
 - d. Payment for transporting, and loading and unloading equipment as above provided will not be made if equipment is used on Work in any other way than upon extra work.
 3. Rental period shall begin at time equipment is unloaded at Site of extra work and terminate at end of day on which Construction Manager directs Contractor to discontinue use of equipment. Excluding Saturdays, Sundays, and legal holidays, unless equipment is used to perform extra work on such days, rental time to be paid per day shall be four (4) hours for zero (0) hours of operation, six (6) hours for four (4) hours of operation and eight (8) hours for eight (8) hours of operation, time being prorated between these parameters. Hours to be paid for equipment, which is operated less than eight (8) hours due to breakdowns, shall not exceed eight (8) less number of hours equipment is inoperative due to breakdowns.
- D. Work Performed by Special Forces or Other Special Services - When Construction Manager and Contractor, by agreement, determine that special service or item of extra work cannot be performed by forces of Contractor or those of any subcontractors, service or extra work item may be performed by specialist. Invoices for service or item of extra work on basis of current market price thereof may be accepted without complete itemization of labor, material, and equipment rental costs when it is impracticable and not in accordance with established practice of special service industry to provide complete itemization. In those instances wherein Contractor is required to perform extra work necessitating a fabrication or machining process in a fabrication or machine shop facility away from Site, charges for that portion of extra work performed in such facility may, by agreement, be accepted as a specialist billing. Construction Manager must be notified in advance of all offsite work. To specialist invoice price, less credit to CLPCCD for any cash or trade discount offered or available, whether or not such discount may have been taken, will be added 15 percent (15%) in lieu of overhead and profit provided in Paragraph 1.04.B.

1.6 FORCE-ACCOUNT

- A. If it is impracticable because of nature of work, or for any other reason, to fix an increase or decrease in price definitely in advance, Change Order may fix a maximum price which shall not under any circumstances be exceeded, and subject to such limitation, such alteration, modification or extra shall be paid for at actual necessary cost as determined by CLPCCD Authority, which cost shall be determined pursuant to Article 1.04, and shall be known as Force-Account work.

- B. Whenever any Force-Account work is in progress, definite price for which has not been agreed on in advance, Contractor shall report to Construction Manager each day in writing in detail amount and cost of labor and material used, and any other expense incurred in Force-Account work on preceding work day, and no claim for compensation for Force-Account work will be allowed unless report shall have been made. Daily report(s) shall be delivered to Construction Manager within one (1) business day of the day the work was performed. No late reports will be accepted. The intent is to have daily agreement on hours expended for labor and equipment on Force-Account work.
- C. Above described methods of determining payment for work and materials shall not apply to performance of work or furnishings of material, which, in judgment of Construction Manager, may properly be classified under items for which prices are established in Contract.

1.7 CLPCCD FURNISHED MATERIALS

CLPCCD reserves right to furnish materials, as it deems advisable, and Contractor shall have no claims for costs and overhead and profit on such materials.

1.8 OVERHEAD DEFINED

- A. The following constitutes charges that are included in overhead for all contract modifications, including Force-Account work:
 - 1. Drawings: field drawings, shop drawings, etc. including submissions of drawings
 - 2. Routine field inspection of work proposed
 - 3. General Superintendence
 - 4. General administration and preparation of change orders
 - 5. Computer services
 - 6. Reproduction services
 - 7. Salaries of project engineer, Construction Manager, superintendent, timekeeper, storekeeper and secretaries
 - 8. Janitorial services
 - 9. Temporary on-site facilities
 - a. Offices
 - b. Telephones
 - c. Plumbing
 - d. Electrical: Power, lighting
 - e. Platforms
 - f. Fencing, etc.
 - 10. Home office expenses
 - 11. Insurance Premium
 - 12. Procurement and use of vehicles and fuel used coincidentally in base bid work
 - 13. Surveying
 - 14. Estimating
 - 15. Protection of work
 - 16. Final cleanup
 - 17. Other incidental work
 - 18. Record Drawings
 - 19. Warranty
 - 20. Transportation expense to site for labor

1.9 RECORDS AND CERTIFICATION

- A. Force-Account (cost reimbursement) charges shall be recorded daily upon Cost Breakdown for Contract Modification Form obtained from Inspector. Contractor or authorized representative shall complete and sign form. Inspector shall sign form for approval. Contract Modification Form shall provide names and classifications of workers and hours worked by

- each, itemize materials used, and also list size type and identification number of equipment, and hours operated, and shall indicate work done by specialists.
- B. No payment for Force-Account work shall be made until Contractor submits original invoices substantiating materials and specialist charges.
 - C. CLPCCD shall have the right to audit all records in possession of Contractor relating to activities covered by Contractor's claims for modification of Contract, including Force-Account work, as set forth in General Conditions.
 - D. Further, CLPCCD shall have right to audit, inspect, or copy all records maintained in connection with this Contract, including financial records, in possession of Contractor relating to any transaction or activity occurring or arising out of, or by virtue of, Contract. If Contractor is a joint venture, right of CLPCCD shall apply collaterally to same extent to records of joint venture sponsor, and of each individual joint venture member.

PART 2 – PRODUCTS

Not applicable to this section.

PART 3 – EXECUTION

Not applicable to this section.

SAMPLE ONLY
COST BREAKDOWN FORM FOR CONTRACT MODIFICATION

One separate form shall be used by Contractor, each first tier subcontractor and each lower tier subcontractor. One form for each shall be used for each change order. One form for each, for each day shall be used for Force-Account work.

COST BREAKDOWN FOR CONTRACTOR PRICE PROPOSAL

SHEET 1 OF 3

GENERAL CONTRACTOR FORM

PROJECT NUMBER: _____

PROJECT NAME: _____

CONTRACTOR : _____

CHANGE ORDER NUMBER : _____ DATE: _____

CHANGE ORDER DESCRIPTION: _____

SUMMARY OF TOTAL COSTS				
1. TOTAL LABOR COSTS		\$	-	
2. Fifteen percent (15%) of Line 1		\$	-	
3. Sum of Lines 1 & 2			\$	-
4. TOTAL MATERIAL COSTS		\$	-	
5. Fifteen percent (15%) of Line 4		\$	-	
6. Sum of Lines 4 & 5			\$	-
7. TOTAL EQUIPMENT RENTAL COSTS		\$	-	
8. Fifteen percent (15%) of line 7		\$	-	
9. Sum of lines 7 & 8			\$	-
10. TOTAL OF SUBCONTRACTED COST		\$	-	
11. Five percent (5%) of line 10 (excluding subcontractor markup)		\$	-	
12. Sum of Lines 10 & 11			\$	-
SUBTOTAL OF DIRECT COSTS & MARK-UP			\$	-
COST OF BONDS (does not apply to subcontractors)			\$	-
TOTAL OF CONTRACT MODIFICATION			\$	-

COST BREAKDOWN FOR CONTRACTOR PRICE PROPOSAL

SHEET 2 OF 3

CONTRACTOR : _____

CHANGE ORDER NUMBER : _____ DATE: _____

CHANGE ORDER DESCRIPTION: _____

LABOR				
NAME	CLASSIFICATION	HOURS	RATE	TOTAL
				\$
				-
				\$
				-
				\$
				-
				\$
				-
TOTAL LABOR COSTS (Transfers to Line 1 of Sheet 1)				\$
				-

MATERIALS	
DESCRIPTION	COST
	\$
SUBTOTAL MATERIAL COSTS (Without Sales Tax)	-
	\$
SALES TAX ON MATERIAL AT 9.00%	-
	\$
TOTAL MATERIAL COSTS (Transfers to Line 4 of Sheet 1)	-
	\$

EQUIPMENT				
SIZE AND TYPE	I.D. #	HOURS	RATE	TOTAL
				\$
				-
				\$
				-
				\$
				-
				\$
				-
TOTAL EQUIPMENT RENTAL COSTS (Transfers to Line 7 of Sheet 1)				\$
				-

	-
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COST BREAKDOWN FORM FOR CONTRACT MODIFICATION

SHEET 3 OF 3

CHANGE ORDER NUMBER : _____ DATE: _____

CHANGE ORDER DESCRIPTION: _____

SUBCONTRACTED WORK		
SUBCONTRACTOR	DESCRIPTION OF WORK SUBCONTRACTED	COST
TOTAL COST OF SUBCONTRACTED WORK (Transfers to Line 10 of Sheet 1)		\$ -

CONTRACTOR: _____ Date: _____

VERIFIED BY INSPECTOR: _____ Date: _____

SECTION 01 3100
PROJECT COORDINATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Project coordination.
- B. Field engineering.
- C. Coordination drawings.
- D. Workmanship.
- E. Incidental costs.
- F. Correspondence and Notices.
- G. Miscellaneous provisions.
- H. Damage and restoration.

1.2 RELATED SECTIONS

- A. Section 01 1100 - Summary of Work.
- B. Section 01 4500 - Quality Control.
- C. Section 01 5000 – Temporary Facilities.
- D. Section 01 7000 - Contract Closeout.

1.3 PROJECT COORDINATION

- A. Coordination scheduling, submittals, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical work, which are indicated diagrammatically on drawings. Follow route shown for pipes, ducts, and conduit, as closely as practicable: place runs parallel with line of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finished elements.
- E. Submit a copy of site drawing and certificate signed by the Civil Engineer that the elevations and locations of the Work of separate Sections in preparation for Substantial Completion.
- F. Coordinate completion and cleanup of Work of separate Sections in preparation for Substantial Completion.
- G. After Owner occupancy of the Site, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.4 FIELD ENGINEERING

- A. Contractor shall locate and protect survey control and reference points.
- B. Control datum for survey is that shown on drawings.

- C. Contractor shall verify setbacks and easements; confirm drawing dimensions and elevations.
- D. Provide field engineering services. Contractor shall establish lines, and levels, utilizing recognized engineering practices

1.5 COORDINATION DRAWINGS

- A. Provide information required by Architect for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

1.6 WORKMANSHIP

- A. Work shall be performed by craftsmen well experienced and competent in their particular trade.
- B. Workmanship shall be thorough, finished and complete in every detail for finest quality installations as intended under these specifications.

1.7 INCIDENTAL COSTS

- A. In addition to cost associated with GC Article 6: Insurance; Indemnity; Bonds:
 - 1. Utilities: Refer to Section 01 50 00.
 - 2. Contractors and Subcontractors shall furnish at their own cost and expense all tools, consumable supplies, appliances, equipment, etc., necessary for execution of their work; and shall be responsible for care and guarding thereof.
 - 3. Contractors and Subcontractors shall be entirely responsible for professional, trade, business or other licenses required by state statute or local government.

1.8 CORRESPONDENCE AND NOTICES

- A. Clearly identify correspondence, notices and submittals with project name, subject and detailed references to drawings and specifications.
- B. Notify Inspector or the Construction Manager two (2) working days in advance of required inspection.
- C. The District's project management system (ProjectSolve) shall be utilized for document controls for RFI, Submittals, Daily Logs, etc.

1.9 MISCELLANEOUS PROVISIONS

- A. Contractor shall immediately refer to the Construction Manager any requirement shown or specified which Contractor in their experience and background finds or believes:
 - 1. Is not equal to industry standards for achieving a first quality installation as intended;
 - 2. Is excessive in cost or effort to effect the intended results;
 - 3. Is below standard for proper enforcement of the guarantees required;
 - 4. Or, is at variance with governing laws, regulations, codes or standards.
- B. Work operations relative to any matter referred to Architect for consideration shall not proceed until receipt of appropriate instructions from Architect.
- C. Inspection of Work and Materials: Contractor shall immediately make a close and thorough inspection of all materials as delivered and all work in progress; shall promptly reject and return all defective materials and re-do; and shall check and verify adequate performance or satisfactory results of all tests and inspections before allowing sub-work to proceed.
- D. Warranty Period: During warranty periods, supervise investigation and correction of deficiencies found or occurring in the work.
- E. Shop Fabricate and pre-assemble interrelated parts where possible.

- F. Closing up of walls, partitions or furred spaces, backfilling and other covering up operations shall not proceed until all enclosed or covered work and inspections have been completed. Verify before proceeding.
- G. Provide holes, slots, cutouts, blocking, screeds, nailers, chases and similar preparation as the work progresses, as required to receive or pass subsequent work without damage to previously completed work.
- H. Exterior Work shall be made tight against direct or indirect entry of water into the concealed or interior spaces of the building. Seal joints or penetrations below grade or behind exterior trim and other conditions where water might enter the structure, as for exposed exterior work.
- I. Structural Connections and Fasteners: Include as required for complete fabrication and installation of the work; of materials, types and sizes adequate for the purposes.
 - 1. Place in concealed or obscured locations where possible.
 - 2. Include suitable welding or brazing where required.
- J. Powder Activated Fasteners: Limited to uses particularly shown, specified or approved by Architect. Operators shall be certified in accordance with California Industry Safety orders.
- K. Ferrous Work permanently exposed to exterior or below grade shall be galvanized; related accessory members and fastening non-ferrous, galvanized or made rustproof by approved methods.
- L. Galvanizing, prime painting and related touch-up and repair shall comply with requirements for metal fabricating and painting in Section 13125 - Relocatable Buildings.
- M. Isolation: Provide between ferrous and non-ferrous or dissimilar metal components to protect the work against electrolysis, as follows:
 - 1. For architectural work, provide cork fillers, asphaltic coatings, neoprene gaskets or similar separation as necessary; and use stainless steel fastenings only where interconnecting dissimilar parts.
 - 2. For mechanical and electrical work, provide dielectric unions or similar separation. In particular, provide isolation as necessary between exterior underground systems and interior above-grade systems where they meet dissimilar metals.
- N. Prior to starting a particular type or kind of work, examine for relevant information, all contract documents and subsequent data issued to the project.

1.10 DAMAGE AND RESTORATION

- A. Damage to previously existing or newly placed facilities caused by movement of equipment or other operations, whether accidental or made necessary by reason of Contract requirements, shall be restored or replaced as specified or directed by Architect or Construction Manager.
- B. Restoration shall be equal to the structural qualities or performance capacities of the original work, and finishes shall match the appearance of, as nearly as possible, like existing adjacent work. Restorations shall be subject to approval by Architect and shall be made as necessary at no added expense to Owner unless otherwise particularly provided for.
- C. Work not properly restored or where not capable of being restored as intended under these Specifications shall be removed and replaced as directed by Architect at no added expense to Owner.

PART 2 – PRODUCTS

Not applicable to this section.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements, which affects:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods, which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
- E. Cut rigid materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Document.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
- J. Identify any hazardous substance or condition exposed during the Work to the Construction Manager for decision or remedy.

END OF SECTION

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SECTION 01 3119

PROJECT MEETINGS

PART1 – GENERAL

1.1 SUMMARY

- A. This section describes the required meetings for this work. These meetings include:
 - 1. Pre-construction Conference
 - 2. Scheduling Meetings
 - 3. Progress Meetings
 - 4. Special Meetings
- B. Related Sections
 - 1. Section 01 1100: Summary of Work
 - 2. Section 01 3200: Progress Schedule
 - 3. Section 01 3300: Submittals

1.2 PRECONSTRUCTION CONFERENCE

- A. Construction Manager will call for and administer Pre-construction Conference at time and place to be announced. Conference will occur as soon after award as can be reasonably scheduled.
- B. Contractor, all subcontractors, and major suppliers shall attend Pre-construction Conference.
- C. Agenda will include, but not be limited to, the following items:
 - 1. Schedules
 - 2. Personnel
 - 3. Use of the Site
 - 4. Temporary Utilities
 - 5. Location of Contractor's on-site facilities
 - 6. Project access
 - 7. Employee parking
 - 8. Security/Safety
 - 9. Housekeeping
 - 10. Submittals
 - 11. Inspection and testing procedures, on-site and off-site
 - 12. Utility shutdown procedures
 - 13. Control and reference point survey procedures
 - 14. Injury and Illness Prevention Program
 - 15. Contractor's Initial CPM Schedule
 - 16. Contractor Invoicing, Schedule of Values, Approval Procedures
- D. Construction Manager will distribute copies of minutes to attendees. Attendees shall have five (5) working days to submit comments or additions to minutes. Minutes will constitute final memorialization of results of the Pre-construction Conference.

1.3 SCHEDULING MEETINGS

- A. Meet with Construction Manager and Architect on Start Date of Contract and conduct initial review of Contractor's draft Shop Drawing and Sample Submittal Schedule, and draft Schedule of Values and Initial Construction Schedule ("Schedule Review Meeting").
- B. Authorized representative in Contractor's organization, designated in writing, who will be responsible for working and coordinating with Construction Manager's representative(s) and

Architect relative to preparation and maintenance of Progress Schedule shall attend initial Schedule Review Meeting.

- C. Contractor shall, within thirty (30) days from the Notice to Proceed date, meet with Construction Manager and Architect to review the Original CPM Schedule submittal.
 - 1. Contractor shall have its manager, superintendent, scheduler, and key subcontractor representatives, as required by CLPCCD, in attendance. The meeting will take place over a continuous one-day period.
 - 2. CLPCCD's review of Schedule Submittals will be limited to conformance to Contract requirements, including, but not limited to, coordination requirements. However, review may also include:
 - a. Clarifications of Contract Requirements
 - b. Directions to include activities and information missing from submittal
 - c. Requests to Contractor to clarify its schedule
 - 3. Within five (5) days of the initial Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by CLPCCD at the meeting.
- D. Construction Manager will administer scheduling meetings and shall distribute minutes of scheduling meetings to attendees. Attendees shall have five (5) working days to submit comments or additions to minutes. Minutes will constitute final memorialization of results of the scheduling meetings.

1.4 PROGRESS MEETINGS

- A. Construction Manager and Architect will schedule and administer Progress Meetings throughout duration of Work. Progress meetings will be held weekly unless otherwise directed by Construction Manager.
 - 1. Meetings shall be held at Construction Manager's on-site office unless otherwise directed by Construction Manager.
 - 2. Construction Manager will prepare agenda and distribute to Contractor, Inspector and Architect/Engineer 24 hours in advance of meeting.
 - 3. Construction Manager will preside at meeting.
 - 4. Architect will record and distribute minutes to Contractor, Inspector, Construction Manager, all other participants, and those affected by decisions made at meeting, within three (3) working days after meeting. Attendees shall have five (5) working days to submit comments or additions to minutes. Minutes will constitute final memorialization of results of progress meetings.
- B. Progress Meetings shall be attended by Contractor's job superintendent, major subcontractors and suppliers, when requested by Construction Manager or as appropriate, Construction Manager, Architect/Engineer, Inspector and others as appropriate to agenda topics for each meeting.
- C. Agenda will contain the following items as appropriate:
 - 1. Review of work progress
 - 2. Status of Construction Schedule, adjustments
 - 3. Submittals
 - 4. Delivery schedules
 - 5. Utility shutdowns, traffic disruptions, and interferences with public scheduled during the subsequent 2 weeks
 - 6. Quality control
 - 7. Pending changes
 - 8. Substitutions
 - 9. Review of Contractor's safety program activities and results, including report on all serious injury and/or damage accidents

10. Safety
 11. Other items affecting progress of work
- D. A separate meeting will be held on approximately the 25th of each month to review the schedule update submittal and progress payment application.
1. At this meeting, at a minimum, the following items will be reviewed:
 - a. percent complete of each activity
 - b. time impact evaluations for Change Orders and Time Extension Request
 - c. actual and anticipated activity sequence changes
 - d. actual and anticipated duration changes
 - e. actual and anticipated contractor delays
 2. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor's General Superintendent and Scheduler.
 3. Contractor shall plan on progress meetings taking no less than four (4) hours.

1.5 SPECIAL MEETINGS

- A. Special meetings may be called by any party by notifying all desired participants, Construction Manager, Architect, and Inspector four (4) working days in advance, giving reason for meeting. Special Meetings may be held without advance notice in emergency situations.
- B. At any time during the progress of the Work, CLPCCD shall have authority to require Contractor to attend conference of any or all of the contractors engaged in the Work or in other work, and notice of such conference shall be duly observed and complied with by Contractor.
- C. Contractor shall schedule and conduct coordination meetings as necessary to discharge coordination responsibilities in the General Conditions. Construction Manager shall be given five (5) days written notice of coordination meetings. Contractors shall maintain minutes of coordination meetings. Attendees shall have five (5) working days to submit comments or additions to minutes. Minutes will constitute final memorialization of results of the meetings.
- D. Pre-installation meetings of manufactures' warranty scope of work, i.e., roofing, water-proofing, curtain wall, etc.
- E. LEED kick-off meeting.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

SECTION 01 3200
PROJECT SCHEDULES AND REPORTS

PART 1 – GENERAL

1.1 SUMMARY

- A. Scheduling of Work under this Contract shall be performed by Contractor in accordance with requirements of this Section.
1. Development of schedule, cost and manpower loading of the schedule and schedule updates, monthly payment requests and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling.
 2. Submit schedules and reports as specified in General Conditions.
- B. Upon Award of Contract, Contractor shall immediately commence development of Initial and Original CPM Schedules to ensure compliance with CPM schedule submittal requirements.
- C. Related Sections:
1. Section 01 1100: Summary of Work
 2. Section 01 3300: Submittal Procedures
- D. Definitions: The following definitions apply to this section:

ACTIVITY:	A task, event or other project element on a schedule that contributes to completing the project. Activities have a description, start date, finish date, duration and one or more logic ties.
BASELINE SCHEDULE:	The initial schedule representing the Contractor's work plan on the first day of the project.
CRITICAL PATH:	The longest continuous chain of activities for the project that has the least amount of total float of all chains. In general, a delay on the critical path will extend the scheduled completion date.
CRITICAL PATH METHOD (CPM):	A network based planning technique using activity durations and the relationships between activities to mathematically calculate a schedule for the entire project.
DATA DATE:	The day after the date through which a schedule is current. Everything occurring earlier than the data date is "as-built" and everything on or after the data date is "planned".
EARLY COMPLETION TIME:	The difference in time between an early scheduled completion date and the contract completion date.
FLOAT:	The difference between the earliest and latest start or finish times for an activity.

MILESTONE:	An event activity that has zero duration and is typically used to represent the beginning or end of a certain stage of the project.
NARRATIVE REPORT:	A document submitted with each schedule that discusses topics related to project progress and scheduling.
NEAR CRITICAL PATH:	A chain of activities with total float exceeding that of the critical path but having no more than 14 calendar days of total float.
SCHED. COMPLETION DATE:	The planned project finish date shown on the current accepted schedule.
SUBSTANTIAL COMPLETION:	The stage in the progress of the work when the work is complete in accordance with the Contract Documents, so that District can occupy or use the work for its intended purpose.
TIME IMPACT ANALYSIS:	A schedule and narrative report developed specifically to demonstrate what effect a proposed change or delay has on the current scheduled completion date.
TIME-SCALED NETWORK DIAGRAM:	A graphic depiction of a CPM schedule comprised of activity bars with relationships for each activity represented by arrows. The tail of each arrow connects to the activity bar for the predecessor and points to the successor.
TOTAL FLOAT:	The amount of time that an activity or chain of activities can be delayed before extending the scheduled completion date.
UPDATED SCHEDULE:	A current schedule developed from the baseline or subsequent schedule through regular monthly review to incorporate as-built progress and any planned changes.

1.2 QUALIFICATIONS

- A. Contractor shall employ experienced scheduling personnel qualified to use the latest version of Primavera Project Planner or Microsoft Project scheduling software. Experience level required is set forth below. Contractor may employ such personnel directly or may employ a consultant for this purpose. After bid opening, the apparent successful low bidder shall provide CLPCCD a written verification that Contractor has the required personnel under its employ or that Contractor will employ the required CPM scheduling consultant.
1. The written statement shall identify individual who will perform CPM scheduling.
 2. Capability and experience shall be verified by description of construction projects on which individual has successfully applied computerized CPM.
 3. Required level of experience shall include at least two projects of similar nature, scope and value not less than three-fourths the Total Bid Price of this Project. The written

statement shall provide contact persons for referenced projects with current telephone and address information.

- B. CLPCCD reserves right to approve Contractor's scheduler, or consultant, and right to reject them at any time. CLPCCD also reserves right to refuse replacement of Contractor's scheduler or consultant, if it believes such replacement will negatively affect Contract.

1.3 GENERAL

- A. Progress Schedule shall be based on and incorporate milestones and completion dates specified in Contract Documents. Submit to the Owner baseline, monthly updated, and final updated schedules, each consistent in all respects with the time and order of work requirements of the contract. Work must be executed in the sequence indicated on the current accepted schedule. Schedules must show the order in which you propose to execute the work with logical links between time-scaled work activities and calculations made using the critical path method to determine the controlling activities. You are responsible for assuring that all activity sequences are logical and that each schedule shows a coordinated plan for complete performance of the work.
- B. Overall time of completion and time of completion for each milestone shown on Progress Schedule shall adhere to times as stated in Contract Agreement, unless an earlier (advanced) time of completion is requested by Contractor and agreed to by CLPCCD. Any such agreement shall be formalized by a Change Order.
 - 1. CLPCCD is not required to accept an earlier (advanced) schedule, i.e., one that shows early completion dates for the Contract Times.
 - 2. Contractor shall not be entitled to extra compensation in the event agreement is reached on an earlier (advanced) schedule and Contractor completes its Work, for whatever reason (excepting approved changes with added time components) beyond completion date shown in earlier (advanced) schedule but within the Contract Times.
 - 3. A schedule showing the work completed in less than the Contract Times, which has been accepted by CLPCCD, shall be considered to have Project Float. The Project Float is the time between the scheduled completion of the work and Contract Substantial Completion. Project Float is a resource available to both CLPCCD and the Contractor.
- C. Float Ownership: Neither CLPCCD nor Contractor owns float. The Project owns the float. As such, liability for delay of the Substantial Completion Date rests with the party whose actions, last in time, actually cause delay to the Substantial Completion Date.
 - 1. For example, if Party A uses some, but not all of the float and Party B later uses remainder of the float as well as additional time beyond the float, Party B shall be liable for the time that represents a delay to the Substantial Completion Date.
 - 2. Party A would not be responsible for the time since it did not consume the entire float and additional float remained; therefore, the Substantial Completion Date was unaffected.
- D. Progress Schedule shall be the basis for evaluating job progress, payment requests, and time extension requests associated with the changes. Responsibility for developing Contract CPM schedule and monitoring actual progress as compared to Progress Schedule rests with Contractor.
- E. The Owner's review and acceptance of schedules does not waive any contract requirements and does not relieve Contractor of any obligation or responsibility for submitting complete and accurate information. Correct rejected schedules and resubmit corrected schedules to the Owner within seven (7) days of notification by the Owner, at which time a new review period of seven (7) days will begin.

Errors or omissions on schedules do not relieve Contractor from finishing all work within the time limit specified for completion of the contract. If, after a schedule has been accepted by

the Owner, either the Contractor or the Owner discovers that any aspect of the schedule has an error or omission, it must be corrected on the next updated schedule.

- F. Use Microsoft Project for Windows or Primavera P6. Such software shall be compatible with Windows operating system. Contractor shall transmit contract schedule files to CLPCCD on CD-ROM or flash drive at times requested by CLPCCD.
- G. Transmit each item under form approved by CLPCCD.
 - 1. Identify Project with CLPCCD Contract number and name of Contractor and file by date, project, and update number.
 - 2. Provide space for Contractor's approval stamp and CLPCCD's review stamps.
 - 3. Submittals received from sources other than Contractor will be returned to the Contractor without CLPCCD's review.

1.4 INITIAL CRITICAL PATH METHOD (CPM) SCHEDULE

- A. Initial CPM Schedule submitted for review at the pre-construction conference shall serve as Contractor's schedule for up to ninety (90) calendar days after the Notice to Proceed.
- B. Indicate detailed plan for the Work to be completed in first sixty (60) days of the Contract; details of planned mobilization of plant and equipment; sequence of early operations; and procurement of materials and equipment. Show Work beyond sixty (60) calendar days in summary form.
- C. Initial CPM Schedule shall be time-scaled.
- D. Initial CPM Schedule shall be cost and manpower loaded. Accepted cost and manpower-loaded schedule will be used as basis for monthly progress payments until acceptance of the Original CPM Schedule. Use of Initial CPM Schedule for progress payments shall not exceed sixty (60) calendar days.
- E. CLPCCD and Contractor shall meet to review and discuss the Initial CPM Schedule within seven (7) calendar days after it has been submitted to CLPCCD.
 - 1. CLPCCD's review and comment on the schedule shall be limited to Contract conformance (with sequencing, coordination, and milestone requirements) and accepted CPM principals.
 - 2. Contractor shall make corrections to schedule necessary to comply with Contract requirements and shall adjust schedule to incorporate any missing information requested by CLPCCD. Contractor shall resubmit Initial CPM Schedule if requested by CLPCCD.
- F. If, during the first sixty (60) days after Notice-to-Proceed, the Contractor is of the opinion that any of the Work included on its Initial CPM Schedule has been impacted, the Contractor shall submit to CLPCCD a written Time Impact Evaluation (TIE) in accordance with Article 1.09 of this Section. The TIE shall be based on the most current update of the Initial CPM Schedule.

1.5 ORIGINAL CRITICAL PATH METHOD (CPM) SCHEDULE

- A. Submit a detailed proposed Original CPM Schedule presenting an orderly and realistic plan for completion of the Work, in conformance with requirements as specified herein.
- B. The baseline schedule must not extend beyond the number of contract days. The baseline schedule must have a data date of the first working day of the contract and not include any completed work to date. The baseline schedule must not attribute negative float or negative lag to any activity.
- C. Progress Schedule shall include or comply with following requirements:
 - 1. Time scaled, cost and manpower loaded CPM schedule.
 - 2. No activity on schedule shall have duration longer than twenty-one (21) calendar days, with exception of submittal, approval, fabrication and procurement activities, unless otherwise approved by CLPCCD.

- a. Activity durations shall be total number of actual days required to perform that activity.
- b. Activity coding capabilities to sort by responsibility, location, phase and CSI division.
3. The start and completion dates of all items of Work, their major components, and milestone completion dates, if any.
4. CLPCCD-furnished materials and equipment, if any, identified as separate activities.
5. Completion of the last activity in the schedule shall be constrained by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. The Contractor shall include as the last activity in the project schedule an activity called "Final Completion". The "Final Completion" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero free float" or "zero total float" are typically prohibited. There shall only be two (2) open ended activities: Start Project (or NTP) with no predecessor logic and Final Completion with no successor logic.
6. Processing/approval of submittals and shop drawings for all Contract-required material and equipment. Activities that are dependent on submittal acceptance or material delivery shall not be scheduled to start earlier than expected acceptance or delivery dates.
 - a. Include time for submittals, resubmittals, and reviews by CLPCCD. Coordinate with accepted schedule for submission of shop drawings, samples and other submittals.
 - b. Contractor shall be responsible for all impacts resulting from resubmittal of shop drawings and submittals.
7. Procurement of all contract required material and equipment, identified as separate activity.
 - a. Include time for fabrication and delivery of manufactured products for the Work.
 - b. Show dependencies between procurement and construction.
8. Complete activity description; what Work is to be accomplished and where.
9. The total cost of performing each activity shall be total of labor, material, equipment, excluding overhead and profit of Contractor. Total overhead and profit of the General Contractor shall be shown on a separate activity in the schedule. Sum of cost for all activities shall equal total Contract value.
10. Resources required (labor) to perform each activity.
11. Responsibility code for each activity corresponding to Contractor or Subcontractor responsible for performing the Work.
12. Identify the activities, which constitute the controlling operations or critical path. No more than twenty-five (25%) of the activities shall be critical or near critical. Near critical is defined as float in the range of one (1) to ten (10) days.
13. At least twenty-eight (28) calendar days for developing punch list(s), completion of punch list items and final clean-up for the Work or any designated portion thereof. No other activities shall be scheduled during this period.
14. Interface with the work of other contractors, CLPCCD, and agencies such as, but not limited to, utility companies.
15. Show detailed Subcontractor Work activities. In addition, furnish copies of Subcontractor schedules upon which CPM was built.
 - a. Also furnish for each Subcontractor, as determined by CLPCCD, submitted on Subcontractor letterhead a statement certifying that Subcontractor concurs with Contractor's Original CPM Schedule and that Subcontractor's related schedules have been incorporated, including activity duration, cost and resource loading.
 - b. Subcontractor schedules shall be independently derived and not a copy of Contractor's schedule.

- c. In addition to Contractor's schedule and resource loading, obtain from electrical, mechanical and plumbing Subcontractors, and other Subcontractors as required by CLPCCD, productivity calculations common to their trades, such as units per person day, feet of pipe per day per person, feet of wiring per day per person, and similar information.
 - d. Furnish schedule for Contractor/Subcontractor CPM Schedule meetings which shall be held prior to submission of Original CPM Schedule to CLPCCD. CLPCCD shall be permitted to attend scheduled meetings as an observer.
16. Activity durations shall be in calendar days.
17. Submit with the schedule a list of anticipated non-Work days, such as weekends and holidays.
- D. Original CPM Schedule Review Meeting: Contractor shall, within thirty (30) calendar days from the Notice to Proceed date, meet with CLPCCD to review the Original CPM Schedule submittal.
 1. Contractor shall have its Construction Manager, Project Superintendent, Project Scheduler, and key Subcontractor representatives, as required by CLPCCD, in attendance. The meeting will take place over a continuous one-day period.
 2. CLPCCD's review will be limited to submittal's conformance to Contract requirements, including, but not limited to, coordination requirements. However, review may also include:
 - a. Accepted critical path method principles and tenets.
 - b. Clarifications of Contract Requirements.
 - c. Directions to include activities and information missing from submittal.
 - d. Requests to Contractor to clarify its schedule.
 3. Within five (5) days of the Schedule Review Meeting, Contractor shall respond in writing to all questions and comments expressed by CLPCCD at the Meeting.

1.6 ADJUSTMENTS TO CRITICAL PATH METHOD (CPM) SCHEDULE

- A. Adjustments to Original CPM Schedule: Contractor shall have adjusted the Original CPM Schedule submittal to address all review comments from original CPM Schedule review meeting and resubmit network diagrams and reports for CLPCCD's review.
 1. CLPCCD, within fourteen (14) days from date that Contractor submitted the revised schedule, will either:
 - a. accept schedule and cost and resource loaded activities as submitted, or
 - b. advise Contractor in writing to review any part or parts of schedule which either do not meet Contract requirements or are unsatisfactory for CLPCCD to monitor Project's progress, resources and status or evaluate monthly payment request by Contractor.
 2. CLPCCD may accept schedule with conditions that the first monthly CPM schedule update be revised to correct deficiencies identified.
 3. When schedule is accepted, it shall be considered as the "Original CPM Schedule" which will then be immediately updated to reflect the current status of the work.
 4. CLPCCD reserves the right to require Contractor to adjust, add to, or clarify any portion of schedule which may later be discovered to be insufficient for monitoring of Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.
- B. Acceptance of Contractor's schedule by CLPCCD will be based upon schedule's compliance with Contract requirements and accepted CPM principles.
 1. By way of Contractor assigning activity durations and proposing sequence of Work, Contractor agrees to utilize sufficient and necessary management and other resources to perform work in accordance with the schedule.
 2. Upon submittal of schedule update, updated schedule shall be considered "current" CPM schedule.
 3. Submission of Contractor's schedule to CLPCCD shall not relieve Contractor of total responsibility for scheduling, sequencing, and pursuing Work to comply with

requirements of Contract Documents, including adverse effects such as delays resulting from ill-timed work.

- C. Submittal of Original CPM Schedule, and subsequent schedule updates, shall be understood to be Contractor's representation that the Schedule meets requirements of Contract Documents and that Work shall be executed in sequence indicated on the schedule.
- D. Contractor shall distribute Original CPM Schedule to Subcontractors for review and written acceptance, which shall be noted on Subcontractors' letterhead to Contractor and transmitted to CLPCCD for the record.

1.7 MONTHLY CPM SCHEDULE UPDATE SUBMITTALS

- A. Following acceptance of Contractor's Original CPM Schedule, Contractor shall monitor progress of Work and adjust schedule each month to reflect actual progress and any pre-approved changes to planned activities or logic.
 - 1. Each schedule update submitted shall be complete, including all information requested for the Original CPM Schedule submittal.
 - 2. Each update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect "as built" information by indicating when activities were actually started and completed.
- B. A meeting will be held on approximately the twenty-fifth (25th) of each month to review the schedule update submittal and progress payment application.
 - 1. At this meeting, at a minimum, the following items will be reviewed: Percent complete of each activity; time impact evaluations for Change Orders and Time Extension Request; anticipated activity sequence changes; anticipated duration changes; actual and anticipated contractor delays.
 - 2. These meetings are considered a critical component of overall monthly schedule update submittal and Contractor shall have appropriate personnel attend. At a minimum, these meetings shall be attended by Contractor's General Superintendent and Scheduler.
 - 3. Contractor shall plan on the meeting taking no less than four (4) hours.
- C. Within seven (7) calendar days after monthly schedule update meeting, Contractor shall submit the updated CPM Schedule update.
- D. Within seven (7) calendar days of receipt of above noted revised submittals, CLPCCD will either accept or reject monthly schedule update submittal.
 - 1. If accepted, percent complete shown in monthly update will be basis for Application for Payment by the Contractor. The schedule update shall be submitted as part of the Contractor's Application for Payment.
 - 2. If rejected, update shall be corrected and resubmitted by Contractor before the Application for Payment is submitted.
- E. Updating, changing or revising of any report, curve, schedule or narrative submitted to CLPCCD by Contractor under this Contract, nor CLPCCD's review or acceptance of any such report, curve, schedule or narrative shall not have the effect of amending or modifying, in any way, the Contract Substantial Completion date or milestone dates or of modifying or limiting, in any way, Contractor's obligations under this Contract.
- F. Final Updated Schedule. Submit final updated, as-built schedule with actual start and finish dates for the activities, within 30 days after completion of contract work. Provide a written certificate with this submittal signed by your Project Manager or an officer of the company stating, "To my knowledge and belief, the enclosed final update schedule reflects that actual start date and finish dates of the actual activities for the project contained herein". An officer

of the company may delegate in writing the authority to sign the certificate to a responsible manager.

1.8 SCHEDULE REVISIONS

- A. Updating the Schedule to reflect actual progress shall not be considered revisions to the Schedule. Since scheduling is a dynamic process, revisions to activity durations and sequences are expected on a monthly basis.
- B. To reflect revisions to the schedule, the Contractor shall provide CLPCCD with a written narrative with a full description and reasons for each Work activity revised. For revisions affecting the sequence of work, the Contractor shall provide a schedule diagram which compares the original sequence to the revised sequence of work. The Contractor shall provide the written narrative and schedule diagram for revisions two (2) working days in advance of the monthly schedule update meeting.
- C. Schedule revisions shall not be incorporated into any schedule update until the revisions have been reviewed by CLPCCD. CLPCCD may request further information and justification for schedule revisions and Contractor shall, within three (3) days, provide CLPCCD with a complete written narrative response to CLPCCD's request.
- D. If the Contractor's revision is still not accepted by CLPCCD, and the Contractor disagrees with CLPCCD's position, the Contractor has seven (7) calendar days from receipt of CLPCCD's letter rejecting the revision, to provide a written narrative providing full justification and explanation for the revision. The Contractor's failure to respond in writing within seven (7) calendar days of CLPCCD's written rejection of a schedule revision shall be contractually interpreted as acceptance of CLPCCD's position, and the Contractor waives its rights to subsequently dispute or file a claim regarding CLPCCD's position.
- E. At CLPCCD's discretion, the Contractor can be required to provide subcontractor certifications of performance regarding proposed schedule revisions affecting said subcontractors.

1.9 RECOVERY SCHEDULE

- A. If the Schedule Update shows a substantial completion date fourteen (14) calendar days beyond the Contract Substantial Completion date, or individual milestone completion dates, the Contractor shall submit to CLPCCD the proposed revisions to recover the lost time within seven (7) calendar days. As part of this submittal, the Contractor shall provide a written narrative for each revision made to recapture the lost time. If the revisions include sequence changes, the Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of work.
- B. The revisions shall not be incorporated into any schedule update until the revisions have been reviewed by CLPCCD.
- C. If the Contractor's revisions are not accepted by CLPCCD, CLPCCD and the Contractor shall follow the procedures in paragraph 1.08.C, 1.08.D and 1.08.E above.
- D. At CLPCCD's discretion, the Contractor can be required to provide subcontractor certifications for revisions affecting said subcontractors.

1.10 TIME IMPACTS EVALUATION (TIE) FOR CHANGE ORDERS, AND OTHER DELAYS

- A. Time Impact Analysis (TIA). Submit a written TIA to the Owner with each request for adjustment of contract time, or when the Contractor or the Owner considers that an approved or anticipated change may impact the critical path or contract progress. The TIA must illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate. The analysis must use the accepted schedule that has a data date closest to and before the event. If the Owner determines that the accepted schedule

- used does not appropriately represent the conditions before the event, the accepted schedule must be updated to the day before the event being analyzed. The TIA must include an impact schedule developed from incorporating the event into the accepted schedule by adding or deleting activities, or by changing durations or logic of existing activities. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted schedule, the difference between scheduled completion dates of the two schedules must be equal to the adjustment of contract time. The Owner may construct and use an appropriate project schedule or other recognized method to determine adjustments in contract time until the Contractor provide the TIA.
- B. Contractor shall be required to comply with the requirements of Paragraph 1.09.A for all types of delays such as, but not limited to, Contractor/Subcontractor delays, adverse weather delays, strikes, procurement delays, fabrication delays, etc.
 - C. Contractor shall be responsible for all costs associated with the preparation of Time Impact Evaluations, and the process of incorporating them into the current schedule update. The Contractor shall provide CLPCCD with 4 copies of each TIE.
 - D. Once agreement has been reached on a TIE, the Contract Times will be adjusted accordingly. If agreement is not reached on a TIE, the Contract Times may be extended in an amount CLPCCD allows, and the Contractor may submit a claim for additional time claimed by Contractor.

1.11 TIME EXTENSIONS

- A. The Contractor is responsible for requesting time extensions for time impacts that, in the opinion of the Contractor, impact the critical path of the current schedule update. Notice of time impacts shall be given in accord with Articles 1.12 and 1.15 of Contract Document General Conditions.
- B. Where an event for which CLPCCD is responsible impacts the projected Substantial Completion date, the Contractor shall provide a written mitigation plan, including a schedule diagram, which explains how (e.g., increase crew size, overtime, etc.) the impact can be mitigated. The Contractor shall also include a detailed cost breakdown of the labor; equipment and material the Contractor would expend to mitigate CLPCCD caused time impact. The Contractor shall submit its mitigation plan to CLPCCD within fourteen (14) calendar days from the date of discovery of said impact. The Contractor is responsible for the cost to prepare the mitigation plan.
- C. Failure to request time, provides TIE, or provides the required mitigation plan will result in Contractor waiving its right to a time extension and cost to mitigate the delay.
- D. No time will be granted under this Contract for cumulative effect of changes.
- E. CLPCCD will not be obligated to consider any time extension request unless requirements of Contract Documents are complied with.
- F. Failure of the Contractor to perform in accordance with the current schedule update shall not be excused by submittal of time extension requests.
- G. If the Contractor does not submit a TIE within the required fourteen (14) calendar days for any issue, it is mutually agreed that the Contractor does not require a time extension for said issue.

1.12 SCHEDULE REPORTS

- A. Submit four (4) copies of the following reports with the Initial CPM Schedule, the Original CPM Schedule, and each monthly update.
- B. Required Reports:
 - 1. Two (2) activity-listing reports: one sorted by activity number and one by total float. These reports shall also include each activity's early/late and actual start and finish

- dates, original and remaining duration, float, responsibility code and the logic relationship of activities.
 - 2. Cost report sorted by activity number including each activity's associated cost, percentage of Work accomplished, earned value to-date, previous payments and amount earned for current update period.
 - 3. Schedule plots presenting time scaled network diagram showing activities and their relationships with the controlling operations or critical path clearly highlighted.
 - 4. Cash flow report calculated by early start, late start and indicating actual progress. Provide an exhibit depicting this information in graphic form.
- C. Furnish CLPCCD with report files in CD ROM and containing all Microsoft Project .mpp or Primavera .xer schedule files along with report files.

1.13 PROJECT STATUS REPORTING

- A. In addition to submittal requirements for CPM scheduling identified in this Section, Contractor shall provide a monthly project status report (i.e., written narrative report) to be submitted in conjunction with each CPM Schedule as specified herein. Status reporting shall be in form specified below.
- B. Contractor shall prepare monthly written narrative reports of status of Project for submission to CLPCCD. Written status reports shall include:
- 1. Transmittal letter
 - 2. Work completed during the period, percent complete of activities
 - 3. Identification of unusual conditions or restrictions regarding labor, equipment or material: including multiple shifts, 6-day work weeks, specified overtime or work at times other than regular days or hours
 - 4. Description of the current critical path
 - 5. Changes to the critical path and scheduled completion date since the last schedule submittal
 - 6. Description of problem areas
 - 7. Current and anticipated delays:
 - 7.1 Cause of delay
 - 7.2 Impact of delay on other activities, milestones and completion dates
 - 7.3 Corrective action and schedule adjustments to correct the delay
 - 8. Contractor may include any other information pertinent to status of Project. Contractor shall include additional status information requested by CLPCCD at no additional cost.
 - 9. Status reports, and the information contained therein, shall not be construed by the Contractor as claims, notice of claims, notice of delay, or requests for changes or compensation.

1.14 WEEKLY SCHEDULE REPORT

At the Weekly Progress Meeting, the Contractor shall provide and present a time scaled four (4) week schedule one (1) week behind and three (3) week look ahead schedule that is based and correlated by activity number to the current schedule (i.e., Initial, Original CPM, or Schedule Update).

1.15 DAILY CONSTRUCTION REPORTS

On a daily basis, Contractor shall submit a daily activity report to CLPCCD for each workday, including weekends and holidays, when worked. Contractor shall develop the daily construction reports on a computer generated database capable of sorting daily Work, manpower and man-hours by Contractor, Subcontractor, area, sub area, and change order work. Upon request of CLPCCD, furnish computer disk of this database. Obtain CLPCCD's written approval of daily construction report database format prior to implementation. Include in report:

- A. Project name and Project number.

- B. Contractor's name and address.
- C. Weather, temperature and any unusual site conditions.
- D. Brief description and location of the day's scheduled activities and any special problems and accidents, including Work of Subcontractors. Descriptions shall be referenced to CPM scheduled activities.
- E. Worker quantities for its own Work force and for Subcontractors of any tier.
- F. Equipment, other than hand tools, utilized by Contractor and Subcontractors.

1.16 PERIODIC VERIFIED REPORTS

The Contractor shall complete and submit the Final Verified Report required by DSA. In addition to other conditions precedent to Final Payment, the Contractor's completion and submission of the Final Verified Report is an express condition precedent to the District's obligation to make the Final Payment. In addition to completion and submission of the Final Verified Report, as a material obligation under the Contract Documents, the Contractor shall comply all DSA requests for reports or other data relating to the Work, the status thereof or conformity of the Work to the Contract Documents.

PART 2 – PRODUCTS

Not applicable to this section.

PART 3 – EXECUTION

Not applicable to this section.

END OF SECTION

SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals including:
 - 1. Procedures
 - 2. Schedule of Shop Drawing and Sample Submittals
 - 3. Safety Plan
 - 4. Progress Schedule
 - 5. Product Data
 - 6. Shop Drawings
 - 7. Samples
 - 8. Quality Control Submittals
 - 9. Design Data
 - 10. Test Reports
 - 11. Certificates
 - 12. Manufacturers' Instructions
 - 13. Machine Inventory Sheets Operations and Maintenance Manuals Computer Programs
 - 14. Project Record Documents
 - 15. LEED Submittals

1.3 RELATED SECTIONS

- A. Section 01 1100: Summary of Work.
- B. Section 01 2600: Contract Modification Procedures.
- C. Section 01 3200: "Progress Schedules and Reports" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
- D. Section 01 7000: Contract Closeout
- E. Section 01 7800: Project Record Documents.

1.4 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.

- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.5 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings are always through Architect for Contractor's use in preparing submittals. Files are used as background use only.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 work days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- E. Submit at own expense, a minimum of two (2) printed sets or copies and one (1) electronic PDF set- Schedule of Shop Drawing and Sample Submittals, Safety Plans, Progress Schedule, Product Data, Shop Drawings, Samples, Quality Control Data, Machine Inventory Sheets, Operations and Maintenance Manuals, Computer Programs, and Project Record Documents required by the Contract Documents.
- F. Transmit each item with a standard letter of transmittal in form approved by Construction Manager.
- G. Identify project, Contractor, subcontractor, major supplier, pertinent drawing sheet and detail number, and specification section number as appropriate. Provide space for Contractor, Construction Manager and Architect/Engineer review stamps.
- H. Where manufacturer's standard drawings or data sheets are used, they shall be marked clearly to show those portions of the data, which are applicable to this project.
- I. Submit Shop Drawings, Samples and other submittals to Construction Manager for review and approval by Architect/Engineer in accordance with accepted schedule of Shop Drawings and Samples submittals. If no such schedule is agreed upon, then all Shop Drawing, Samples and product data submittals shall be completed within ninety (90) days after receipt of Notice to Proceed from CLPCCD.

- J. The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show Architect/Engineer the materials and equipment Contractor proposes to provide and to enable Architect/Engineer to review the information for the limited purposes specified below. Samples shall be identified clearly as to material, supplier, pertinent data such as catalog numbers and the use for which it is intended and otherwise as Architect/Engineer may require enabling Architect/Engineer to review the submittal. The number of each Sample to be submitted will be as specified in the Specifications.
- K. At the time of each submission, Contractor shall give Construction Manager, Architect/Engineer, and Inspector specific written notice of all variations, if any; that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, and the reasons therefore. This written notice shall be in a written communication separate from the submittal. In addition, Contractor shall cause a specific notation to be made on each Shop Drawing and Sample submitted to Construction Manager for review and approval of each such variation by Architect/Engineer. The Architect/Engineer may make adjustments to submittals that may result in changes to the contract. The appropriate change order request should be prepared by the Contractor within ten (10) days of receipt of submittals.
- L. If CLPCCD accepts deviation, CLPCCD shall issue appropriate Contract Modification.
- M. Submittal coordination and verification is responsibility of Contractor; this responsibility shall not be delegated in whole or in part to subcontractors or suppliers. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:
1. All field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto;
 2. All materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work; and
 3. All information relative to Contractor's sole responsibilities and of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.
- N. Contractor shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.
- O. Contractor's submission to Construction Manager of a Shop Drawing or Sample submittal will constitute Contractor's representation that it has satisfied its obligations under the Contract Documents, and as set forth immediately above, with respect to Contractor's review and approval of that submittal.
- P. Designation of work "by others", if shown in submittals, shall mean that work will be responsibility of Contractor rather than subcontractor or supplier who has prepared submittals.
- Q. After review by Architect/Engineer of each of Contractor's submittals, one electronic set will be returned to Contractor with actions defined as follows:
1. NO ACTION TAKEN – Submittal is unreviewed.
 2. NO EXCEPTIONS TAKEN - Accepted subject to its compatibility with future submittals and additional partial submittals for portions of the work not covered in this submittal. Does not constitute approval or deletion of specified or required items not shown on the submittal.
 3. MAKE CORRECTIONS NOTED (NO RESUBMISSIONS REQUIRED) - Same as 2. above, except that minor corrections as noted shall be made by Contractor.

4. REVISE AND RESUBMIT - Rejected because of major inconsistencies or errors which shall be resolved or corrected by Contractor prior to subsequent review by Architect/Engineer.
 5. REJECTED (RESUBMIT) - Submitted material does not conform to Plans and Specifications in major respect, i.e.: wrong size, model, capacity, or material.
- R. It is considered reasonable that Contractor shall make a complete and acceptable submittal at least by second submission.
1. CLPCCD reserves the right to deduct monies from payments due Contractor to cover additional costs of Architect's/Engineer's review beyond the second submission. Illegible submittals will be rejected and returned to Contractor for resubmission.
- S. Favorable review will not constitute acceptance by CLPCCD or Architect/Engineer of any responsibility for the accuracy, coordination and completeness of the submittals. Accuracy, coordination, and completeness of Submittals shall be sole responsibility of Contractor, including responsibility to back check comments, corrections, and modifications from CLPCCD's or Architect's/Engineer's review before fabrications. Submittals may be prepared by Contractor, subcontractors, or suppliers, but Contractor shall ascertain that submittals meet requirements of Contract Documents, while conforming to structural space and access conditions at point of installation. Architect/Engineer's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Favorable review of submittal, method of work, or information regarding materials and equipment Contractor proposes to furnish shall not relieve Contractor of responsibility for errors therein and shall not be regarded as assumption of risks or liability by Architect/Engineer or CLPCCD, or any officer or employee thereof, and Contractor shall have no claim under Contract on account of failure or partial failure or inefficiency or insufficiency of any plan or method of work or material and equipment so accepted. Favorable review shall be considered to mean merely that Architect/Engineer or CLPCCD has no objection to Contractor using, upon his own full responsibility, plan or method of work proposed, or furnishing materials and equipment proposed.
- T. Architect's/Engineer's review will not extend the means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
- U. Submit complete initial submittal for those items where required by individual specification Sections. Complete submittal shall contain sufficient data to demonstrate that items comply with Specifications, shall meet minimum requirements for submissions cited in technical specifications, shall include motor data and seismic anchorage certifications, where required, and shall include necessary revisions required for equipment other than first named. If Contractor submits incomplete initial submittal, when complete submittal is required, submittal may be returned to Contractor without review.
- V. It shall be Contractor's responsibility to copy, conform and distribute reviewed submittals in sufficient numbers for Contractor's files, subcontractors and vendors.
- W. After Architect/Engineer review of submittal, revise and resubmit as required. Identify changes made since previous submittal.
1. Begin no fabrication or work, which require submittals until return of submittals not requiring resubmittal.
 2. Normally, submittals will be processed and returned to Construction Manager within fifteen (15) working days of receipt by Architect. The processing time spent to review submittals by Construction Manager shall be in addition to the fifteen (15) days.

3. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.

1.6 SCHEDULE OF SHOP DRAWING, DSA DEFERRED APPROVAL SUBMITTALS AND SAMPLE SUBMITTALS

- A. Submit preliminary Schedule of Shop Drawing and Sample Submittals as required by General Conditions. Submit two (2) copies and one (1) electronic PDF of final and accepted schedule of submittals of shop drawings and samples as required by General Conditions, and in no event later than thirty (30) days following Notice of Award.
- B. Schedule of Shop Drawing and Sample Submittals will be used by Architect/Engineer to schedule their activities relating to review of submittals. Schedule of submittals shall indicate a spreading out of submittals and early submittals of long lead-time items and of items, which require extensive review.
- C. Schedule of Shop Drawing and Sample Submittals shall be reviewed by Construction Manager and shall be revised and resubmitted until accepted by Construction Manager.
- D. DSA Deferred Approval Submittals shall be prepared for review by the Architect/Engineer within 30 days of receipt of Notice to Proceed. Contractor shall promptly make corrections to documents for Architect to submit to DSA for approval. Contractor shall have the sole responsibility for obtaining DSA approval via the Architect's office for all deferred approval submittals in a timely manner. There will be no time extensions granted for delay in obtaining such approval.

1.7 SAFETY PLAN

- A. Submit one (1) copies and one (1) electronic PDF of Safety Plan specific to this Contract to Construction Manager within fifteen (15) calendar days after Start Date of the Contract Time.
- B. No on-site work shall be started until Safety Plan has been reviewed and accepted by CLPCCD. Acceptance of Safety Plan shall not affect Contractor's responsibility for maintaining a safe working place and instituting safety programs in connection with project in full compliance with local, state and federal regulations.

1.8 PROGRESS SCHEDULE

- A. Schedule all items requiring Architect action for submission during first 25 percent of construction period.
- B. See Section 01 32 00 "Progress Schedules and Reports" for schedule and report requirements.
- C. Submit (3) print copies, one (1) electronic report file in PDF format, and either Microsoft Project .mpp or Primavera .xer schedule program files:
 1. Initial CPM Schedule at the Pre-construction Conference.
 2. Original CPM Schedule within thirty (30) days of Notice to Proceed (NTP).
 3. Adjustments to the CPM Schedule as required.
 4. CPM Schedule updates monthly, five (5) days prior to monthly progress meeting.
- D. Submit three (3) copies and one (1) electronic PDF copy of the reports listed in Section 01 32 00 "Progress Schedules and Reports" with:

1. Initial CPM Schedule
 2. Original CPM Schedule
 3. Each monthly Schedule update
 4. Each weekly three (3) week look ahead Schedule
- E. Progress Schedules and Reports shall be submitted electronically, in addition to hard copies as specified above.

1.9 QUALITY CONTROL SUBMITTALS

- A. Design Data: Not applicable.
- B. Test Reports: Three (3) copies minimum. One (1) copy will be marked with Architect's/Engineer's review comments and returned to Contractor.
1. Indicate that material or product conforms to or exceeds specified requirements.
 2. Reports may be from recent or previous tests on material or product, but must be acceptable to Construction Manager. Comply with requirements of each individual specification Section.
- C. Certificates: Three (3) copies minimum. One (1) copy will be marked with Architect's/Engineer's review comments and returned to Contractor.
1. Indicate that material or product conforms to or exceeds specified requirements.
 2. Submit supporting reference data, affidavits, and certifications as appropriate.
 3. Certificates may be recent or from previous test results on material or product, but must be acceptable to Construction Manager.
- D. Manufacturers' Instructions: Three (3) copies minimum. One (1) copy will be marked with Architect's/Engineer's review comments and returned to Contractor.
1. Include manufacturer's printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing.
 2. Identify conflicts between manufacturer's instructions and Contract Documents.

1.10 COMPUTER PROGRAMS

- A. When any equipment requires operation by computer programs, submit copy of program on CD(s) plus all user manuals and guides for operating the programs and making changes in the programs for upgrading and expanding the databases. Provide required licenses to CLPCCD at no additional cost.
1. Include at least three (3) years prepaid software license renewals, which includes software upgrades and updates.

1.11 PROJECT RECORD DOCUMENTS

- A. Submit one copy of each of the Project Record Documents listed in Section 01 70 00 Contract Closeout.

1.12 DELAY OF SUBMITTALS

- A. Delay of submittals by Contractor is considered avoidable delay. Liquidated damages incurred because of late submittals will be assessed to the Contractor.

PART 2 - PRODUCTS

2.1 SUBMITTALS

- A. Within fifteen (15) calendar days after Start Date of the Contract Time submit two (2) copies and one (1) electronic PDF of complete list of substitutions of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. Contractor shall be responsible for and make all submissions.
 - 1. Submit items specified herein to Architect and Construction Manager.
 - 2. Submit all submittals through the Construction Manager's Electronic Submittal Program.
 - 3. Identify each transmittal using the 6-digit specification number, i.e., metal handrails might be numbered 05 5000, along with an individual submittal number for each section number. Submittal numbers shall be sequential. If returning submittal "12" for re-submission, second submission would be identified as "12A". Should submittal be rejected multiple times (12b, 12c, etc), the Contractor may be required to reimburse the Owner/Architect for labor to review subsequent submissions.
 - 4. Develop, for maintenance by the Construction Manager, a schedule of all submittals and their status. Refer to Paragraph 1.3 below. The schedule will be reviewed each week at the project meeting.
- C. Transmittals, shop drawings, or samples submitted to Architect shall have the Contractor's stamp on it with his signature and be marked "approved." Contractor's stamp on these items indicates that Contractor has performed the following:
 - 1. Verified field dimensions and quantities.
 - 2. Verified field construction criteria, materials, catalog numbers and similar data.
 - 3. Reviewed and coordinated submittal data with requirements of the Work and the Contract Documents.
 - 4. ITEMS NOT STAMPED BY THE CONTRACTOR WILL BE RETURNED UNREVIEWED.
- D. Indicate any item, component, material or portion of Work, which deviates from Contract Documents. Unless such departures are accepted as indicated in paragraph "Review" below, such departures will not be permitted.
- E. Make submittals sufficiently in advance of data required to allow Architect reasonable time for review and additional resubmission and review cycles if necessary.
 - 1. Items submitted without Contractor's review stamp will be returned, without action, for resubmission.
 - 2. Items not submitted in accordance with provisions of this Section will be returned, without action, for resubmission.
 - 3. Submissions on items not approved for use by specifications or addenda will be rejected.
 - 4. Drawings transmitted by other than the Prime Contractor will be returned to the Prime Contractor without action of any kind. Drawings will not be returned to subcontractors.

2.2 SUBMITTALS – PRODUCT DATA

- A. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
- B. Tabulate products by specification section number.

- C. Supplemental Data:
 - 1. Submit number of copies, which Contractor requires, plus three (3) copies, which will be retained by Construction Manager.
 - 2. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to Project.
- D. Provide copies for Project Record Documents described in Section 01 70 00 Contract Closeout.

2.3 SUBMITTALS - SHOP DRAWINGS

- A. Identify drawings with manufacturer, item, use, type, project designation, specification section or drawing detail reference.
- B. Minimum Sheet Size: 8-1/2 inches by 11 inches. All others: Multiples of 8-1/2 inches by 11 inches, 34 inches by 44 inches maximum.
- C. For 8-1/2 inch by 11 inch and 11 inch by 17-inch sheets, submit number of copies, which contractor requires plus three (3) copies, which will be retained by Construction Manager.
- D. For 17 inch by 22 inch through 34 inch by 44-inch sheets, submit one [1] electronic and a minimum of three [3] prints. After review, reproduce and distribute.
- E. Original sheet or reproducible transparency will be marked with Architect's/Engineer's review comments and returned to Contractor.
- F. Each sheet/copy must include project name and project number and bid number on all sheets.
- G. Mark each copy to identify applicable Products, models, options, and other data; supplement manufacturers' standard data to provide information unique to Work.
- H. Include manufacturers' installation instructions when required by specification section.
- I. Submit a copy of the Shop Drawing Transmittal Form with each submittal and resubmittal.

2.4 SUBMITTALS - SAMPLES

- A. Identify samples with manufacturer's name, item, use, type, project designation, specification section or drawing detail reference, color, range, texture, finish and other pertinent data.
 - 1. Submit samples to illustrate functional and aesthetic characteristics of Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- B. Submit full range of manufacturers' standard colors, textures, and patterns for Construction Manager's selection.
- C. Submit a minimum of three (3) samples unless otherwise specified in the construction documents.
- D. Sizes: Unless otherwise specified, provide the following:
 - 1. Paint Chips: Manufacturers' standard
 - 2. Flat or Sheet Products: Minimum 6 inches square, maximum 12 inches square
 - 3. Linear Products: Minimum 6 inches, maximum 12 inches long

4. Bulk Products: Minimum 1 pint, maximum 1 gallon.
- E. Full size samples may be used in Work upon approval.
- F. Mock-ups:
 1. Erect field samples and mock-ups at Project site in accordance with requirements of Specification sections.
 2. Modify or make additional field samples and mock-ups as required to provide appearance and finishes approved by Construction Manager.
 3. Approved field samples and mock-ups may be used in Work upon approval.
- G. Architect may, at his option, retain samples for comparison purposes until completion of Work.
 1. Samples will be returned or may be used in the Work unless the technical section specifically indicates otherwise.
 2. Remove samples when directed.
 3. Pay all costs of furnishing or constructing, and removing samples.
- H. Resubmit samples of rejected items.
- I. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- J. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT REVIEW

- A. General: Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- B. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Reproduce and distribute submittals that the Architect reviews and stamps as follows, to indicate the action taken:
1. Reviewed: Where submittal is marked "Reviewed," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 2. Reviewed -- Additional Information Required: Where submittal is marked "Reviewed -- Additional Information Required," the information submitted has been reviewed and approved as noted. However, additional information as noted and/or required by Contract Documents needs to be submitted.
 3. Make Corrections As Noted: When submittal is marked "Furnish As Corrected," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 4. Submit Specified Item: When submittal is marked "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
 5. Rejected: When submittal is marked "Rejected," information submitted is not in compliance with Contract Documents. Resubmit submittal as required by Contract Documents.
- D. Contractor shall retain 1 copy of each "Reviewed," "Reviewed -- Additional Information Required" or "Furnish as Corrected" submittal on file at the job site.
- E. Architect shall retain 1 copy of each "Reviewed," "Reviewed -- Additional Information Required" or "Furnish as Corrected" submittal in the project file.
- F. Contractor shall resubmit items stamped "Revise and Resubmit" or "Rejected" by Architect.
1. Provide a print of previous drawing with resubmission for comparison.
 2. Add letter suffix to previous transmittal number, to indicate resubmission.
 3. It shall be the Contractor's responsibility to assure that previously approved documents are destroyed when they are superseded by a resubmittal.
- G. Architect review is general and does not:
1. Permit departure from Contract Documents.
 2. Relieve Contractor from responsibility for errors in detail, in dimensions or related items.
 3. Approve departure from previous instructions or details.
 4. Relieve Contractor of the responsibility to provide all components, wiring, etc., required to make item operable or usable.
 5. Imply acceptance of items for which no data is submitted.
- H. For items constituting a departure from Contract Documents see Section 01 2500.
- I. Reviewed samples submitted or constructed and approved by Architect constitute criterion for judging completed work. Finish work or items not equal to samples will be rejected.

- J. Start of work which requires submittals, prior to return of submittals with Architect or Owner's stamp indicating review and approval is at Contractor's risk.

3.3 DISTRIBUTION

- A. Contractor shall copy and distribute all "Reviewed," "Reviewed -- Additional Information Required" or "Furnish as Corrected" submittals, including one copy to the Owner.

END OF SECTION

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SECTION 01 4100
REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

This section includes regulatory requirements applicable to Contract.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

- A. Codes, laws, ordinances, rules and regulations referred to shall have full force and effect as though printed in full in these specifications.
- B. Conform to referenced codes, laws, ordinances, rules and regulations, which are in effect on date of receipt of bids.

1.3 CODES

Codes, which apply to Contract, include, but are not limited to, the following:

- A. 2019 California Building Code (Part 2, Title 24, C.C.R.)
- B. 2019 California Electrical Code (Part 3, Title 24, C.C.R.)
- C. 2019 California Mechanical Code (Part 4, Title 24, C.C.R.)
- D. 2019 California Plumbing Code (Part 5, Title 24, C.C.R.),
- E. 2019 State Elevator Safety Regulations (Part 7, Title 24, C.C.R.)
- F. 2019 California Fire Code (Part 9, Title 24, C.C.R.)
- G. 2019 California Energy Code (Part 6, Title 24, C.C.R.)

1.4 LAWS, ORDINANCES, RULES AND REGULATIONS

- A. During prosecution of Work to be done under Contract, comply with applicable laws, ordinances, rules and regulations, including, but not limited to, the following:
- B. Federal
 - 1. Americans With Disabilities Act
 - 2. 29 CFR, Section 1910.1001, Asbestos
 - 3. 40 CFR, Subpart M, National Emission Standards for Asbestos
 - 4. Executive Order 11246
- C. State of California
 - 1. California Code of Regulations, Titles 5, 8, 19, 21, 24
 - 2. California Education Code
 - 3. California Public Contract Code
 - 4. California Health and Safety Code
 - 5. California Government Code
 - 6. California Labor Code
 - 7. California Civil Code
 - 8. California Code of Civil Procedure
 - 9. CPUC General Order 95, Rules for Overhead Electric Line Construction
 - 10. CPUC General Order 128, Rules for Construction of Underground Electric Supply and Communications Systems
- D. State of California Agencies
 - Bay Area Air Quality Management District (BAAQMD / www.baaqmd.gov)

State and Consumer Services Agency

Department of General Services

Division of the State Architect Office of the State Fire Marshall Office of Public School
Construction

E. Local Agencies:

City of Hayward, California (www.ci.hayward.ca.us)

1.6 COMPLIANCE WITH AMERICANS WITH DISABILITIES ACT

- A. Contractor acknowledges that, pursuant to the Americans with Disabilities Act (ADA), programs, services and other activities provided by a public entity to the public, whether directly or through a contractor, must be accessible to the disabled public. Contractor shall provide the services specified in this Agreement in a manner that complies with the ADA and any and all other applicable federal, state and local disability rights legislation. Contractor agrees not to discriminate against disabled persons in the provision of services, benefits or activities provided under this Agreement and further agrees that any violation of this prohibition on the part of Contractor, its employees, agents or assigns shall constitute a material breach of this Agreement.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END OF SECTION

SECTION 01 4110
REGULATORY REQUIREMENTS – HAZARDOUS WASTE

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes regulatory requirements applicable to Contract work in connection with hazardous waste abatement and disposal, including, but not limited to, asbestos and asbestos containing materials, lead based paint, polychlorinated biphenyls, petroleum contaminated soils and materials, construction and demolition debris and any other hazardous substance or hazardous waste.
- B. This section supplements Section 01 41 00 and the work specific listings of applicable regulatory requirements elsewhere in the specifications.
- C. Related Sections.
 - 1. Section 01 41 00: Regulatory Requirements.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

- A. Codes, laws, ordinances, rules and regulations applicable to the Work shall have full force and effect as though printed in full in these specifications. Codes, laws, ordinances, rules and regulations are not furnished to Contractor, since Contractor is assumed to be familiar with their requirements. The listing herein of applicable codes, laws and regulations for hazardous waste abatement work is supplied to Contractor as a courtesy and shall not limit Contractor's responsibility for complying with all applicable laws, regulations or ordinances having application to the Work. Where conflict among the requirements or with these specifications exists, the most stringent requirements shall be used.
- B. Contractor's work shall conform to all applicable codes, laws, ordinances, rules and regulations that are in effect on date of receipt of bids.

1.3 LAWS, ORDINANCES, RULES AND REGULATIONS

- A. During prosecution of Work under Contract, Contractor shall comply with applicable laws, ordinances, rules and regulations, including, but not limited to, those listed below.
- B. Federal:
 - 1. Statutory Requirements:
 - a. Resource Conservation and Recovery Act, 42 U.S.C.. 6901 et seq.
 - b. Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986,42 U.S. C" 9601 et seq.
 - c. Toxic Substances Control Act of 1976,15 U.S.C.. 2601 et seq.
 - d. Hazardous Materials Transportation Act of 1975, 49 U.S. C" 1801 et seq.
 - e. Clean Water Act, 33 U.S.C.. 1251 et seq.
 - f. Safe Drinking Water Act, 42 U.S. C.. 3001 et seq.
 - g. Clean Air Act, section 112, 42 U.S. C.. 7412
 - h. Occupational Safety and Health Act of 1970, 29 U.S.C.. 651 et seq.
 - i. Underground Storage Tank Law, 42 U.S. C.. 6991 et seq.
 - j. The Emergency Planning and Community Right to Know Act of 1986,42 U.S.C.. 11001 et seq.
 - 2. Environmental Protection Agency (EPA):
 - a. 40 C.F.R. Parts. 260, 264, 265, 268, 270
 - b. 40 C.F.R. Parts 258 et seq.
 - c. 40 C.F.R. Part 761
 - d. 40 C.F.R. Parts 122-124

3. Occupational Safety and Health Administration (OSHA):
 - a. OSHA Worker Protection Standards, Title 29 CFR Part 1926.58, Construction Standards and 29 CFR 1910.1001 General Industry Standard
 - b. OSHA, 29 C. F. R. Part 1926.1101, Construction Standards for Asbestos
 - c. OSHA, Lead Exposure in Construction: Interim Final Rule, 29 C.F.R. 1926.62
 - d. National Emission Standard for Hazardous Air Pollutants, Title 40 CFR Part 61
 - e. Asbestos Hazardous Emergency Response Act, Title 40 C.F.R. 763
 4. Department of Transportation:
 - a. Title 49 C.F.R. 173.1090
 - b. Title 49 C.F.R.172
 - c. Title 49 C.F.R. 173
 - d. DOT, HM 181 and MH126f
- C. State of California Requirements:
1. Statutory Law:
 - a. The Carpenter-Presley-Tanner Hazardous Substance Account Act, Cal. Health & Saf. Cod~ 25300 et seq.
 - b. Health and Safety Cod~ 25359.4
 - c. Hazardous Waste Control Law, Health & Safety Code. 25100 § seq.
 - d. Porter Cologne Water Quality Control Act, Cal. Water Cod~ 13000 et seq.
 - e. Health and Safety Cod~ 25915-25924
 - f. Cal. Labor Code Chapter 6, including, without limitation,. 6382, 6501.5-6501.9,6503.5, 9021.5, 9080
 - g. Cal. Bus. and Prof. Code, including without limitation,. 7058.5, 7065.01, 7118.5. Underground Storage of Hazardous Substance Act,
 - h. Cal. Health & Saf. Cod~ 25280 § seq.
 - i. Petroleum Underground Storage Tank Cleanup, Health and Safety Cod~ 25299.10 et seq.
 - j. Safe Drinking Water and Toxic Enforcement Act of 1986, Health & Saf. Cod~ 25249.5 et seq. (Proposition 65)
 - k. Above Ground Petroleum Storage Act, Health and Safety Code. 25270 et seq.
 2. Hazardous Materials Release Response Plans and Inventory, California Health and Safety Code Chapter 6.95.
 3. Administrative Code and Regulations:
 - a. 22 C.C.R.. 6600 et seq.
 - b. Title 22 C.C.R.. Standards for Management of Hazardous and Extremely Hazardous Waste
 - c. DTSC Treatment Standard for PCB Wastes, Title 22 C.C.R.,. 66268.110
 - d. Cal OSHA Worker Protection Standards, Title 8 C.C.R.. 1529, 5208
 - e. Title 8 C. C. R.. 1532.1, Lead in Construction
 - f. 22 C.C.R.. 66999(b)
 - g. Title 23 C.C.R.. 2610 et seq.
 4. Local Agency Requirements:
 - a. Bay Area Air Quality Management District, Fugitive Dust Rules
 - b. Bay Area Air Quality Management District Regulation 11-2-303
 - c. State Water Resource Control Board, General Construction Activity Stormwater Permit Requirements (Order 92-0S DWQ)
 5. City Requirements:
 - a. Hayward Fire Department (www.haywardcal.us/fire_dept/fd.htm)
 - b. Ordinances

1.4 PERMITS

- A. Contractor shall comply with, implement or acknowledge effectiveness of all CLPCCD held permits, and initiate and cooperate in securing all required notifications or approvals therefore, including but not limited to permits affecting environmental work and the following:
 1. BAAQMD, Permit to Excavate or Treat Contaminated Soil;

2. State Water Resources Control Board, General Construction Activity Stormwater Permit

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

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SECTION 01 4113

ADDITIONAL REQUIREMENTS FOR DSA REVIEWED PROJECTS

PART 1 – GENERAL

1.1 DSA DEFERRED APPROVALS

- A. Refer to Contract Drawings.

1.2 INSPECTION AND SUPERVISION

- A. Supervision by DSA shall be in accordance with Section 4-334 of Part 1, Title 24, CCR.
- B. District shall employ a full-time Project Inspector approved by DSA. The Project Inspector shall observe construction in accordance with Section 4-333(b) and 4-342 of Part 1, Title 24, CCR.
- C. Reports: Project Inspector shall submit the following in accordance with DSA IR A-7.
 - 1. Start of Project Report: Notify DSA of start of construction in accordance with Section 4-331 of Part 1, Title 24, CCR.
 - 2. Semi-Monthly Reports: Comply with Section 4-337 of Part 1, Title 24, CCR.
 - 3. Verified Reports: Comply with Section 4-336 of Part 1, Title 24, CCR.
- D. Special Inspection Requirements:
 - 1. Comply with Section 4-333(c) of Part 1, Title 24, CCR.
 - 2. Special inspection costs are to be paid by the Owner.
 - 3. Conduct special inspection as per DSA Structural Tests and Inspections Sheet (SSS 103-1).

1.3 TESTING LABORATORY REQUIREMENTS

- A. Comply with Section 4-335 of Part 1, Title 24, CCR.
- B. The Owner shall select the testing Laboratory approved by DSA, Architect, and Structural Engineer.
- C. Sampling and testing shall be performed by properly qualified persons in accordance with American Society for Testing and Materials (ASTM) standards.
- D. Conduct tests as per DSA Structural Tests and Inspections Sheet (SSS 103-1).
- E. Submit one copy of test reports to DSA.

1.4 ADDENDA AND CHANGE ORDERS

- A. Comply with Section 4-338 of Part 1, Title 24, CCR.
- B. Comply with DSA IR A-6.
- C. Obtain DSA approval for changes to code-regulated construction and inspection/testing functions prior to start of that work. Code-regulated construction refers to work that is regulated by code provisions applicable to public school construction, including those adopted by DSA Structural Safety (DSA/SS), DSA Access Compliance (DSA/AC) and State Fire Marshal (SFM).
- D. Changes can be approved through either the change order (CO) process or preliminary change order (PCO) process. Comply with DSA IR A-6, Sub-paragraph 2.2 - Change Order Process and DSA IR A-6, Sub-paragraph 2.1 - Preliminary Change Order Process.
- E. Do not begin any work under addendum or change order until required DSA written approval is obtained.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 4200

REFERENCES AND DEFINITIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes reference standards, abbreviations, symbols and definitions used in Contract Documents.
- B. Full titles and edition dates are given in this section for standards cited in other sections of Specifications.
- C. Material and workmanship specified by reference to number, symbol, or title of specific standard such as state standard, commercial standard, federal specifications, technical society, or trade association standard, or other similar standard shall comply with requirements of standards except when more rigid requirements are specified or required by applicable codes.
- D. Standards referred to, except as modified herein, shall have full force and effect as though printed in the Contract Documents. Standards are not furnished to Contractor, since manufacturers and trades involved are assumed to be familiar with their requirements.

1.2 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES;
REPORTING AND RESOLVING DISCREPANCIES:

- A. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or laws or regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated in the Contract Documents.
- B. If during the performance of the Work, Contractor discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such law or regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any supplier, Contractor shall report it in writing at once to Inspector, with copies to Construction Manager and Architect, and Contractor shall not proceed with the Work affected thereby until consent to do so is given by the Construction Manager.
- C. Except as otherwise specifically stated in the Contract Documents or as may be provided by Change Order, or supplemental instruction, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the Contract Documents and:
 1. The provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or
 2. The provisions of any such laws or regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such law or regulation).

No provision of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of CLPCCD, Contractor, Construction Manager, or Architect/Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents, nor shall it be effective to assign to CLPCCD, Architect/Engineer, Construction Manager, or any of their consultants, agents or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

1.3 STANDARDS

- A. ACI (American Concrete Institute)
Standard 318, Building Code Requirements for Reinforced Concrete
- B. AISC (American Institute of Steel Construction)
Specifications and Code of Standard Practice for Steel Buildings and Bridges
- C. ANSI (American National Standards Institute, formerly American Standards Association)
Standard C2, NESC (National Electrical Safety Code)
- D. ASTM (American Society for Testing and Materials)
 - 1. C31, Making and Curing Concrete Test Specimens in the Field
 - 2. C42, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - 3. C143, Test Method for Slump of Portland Cement Concrete
- E. IAPMO (International Association of Plumbing and Mechanical Officials)
- F. ICC (International Code Council)
 - 1. Refer to Section 01 41 00 – Regulatory Requirements
- G. NEMA (National Electric Manufacturer's Association)
- H. NFPA (National Fire Protection Association)
 - 1. Pamphlet 1, Fire Prevention Code
 - 2. Pamphlet 13, Sprinkler Systems, Installation
 - 3. Pamphlet 24, Private Fire Service Mains
 - 4. Pamphlet 70, NEC (National Electric Code)
 - 5. Pamphlet 71, Signaling Systems, Central Station
 - 6. Pamphlet 80, Fire Doors and Windows
 - 7. Pamphlet 101, Life Safety Code
- I. UL (Underwriters' Laboratories, Inc.)

1.4 ABBREVIATIONS

- A. Following abbreviations may be used in Contract Documents:

AAP	Affirmative Action Program
ACI	American Concrete Institute
ADA	American Disabled Act
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute (formerly American Standards Association)
ASI	Architect's Supplemental Instructions
ASTM	American Society for Testing and Materials
BIL	Basic Insulation Level
Cal/OSHA	California Occupational Safety and Health Administration
CCD	Construction Change Directive
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CO	Change Order
CPUC	California Public Utilities Commission
CPM	Critical Path Method
DSA	Division of State Architect
HVAC	Heating, Ventilating and Air Conditioning
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
I.D.	Identification

JATC	Joint Apprenticeship Training Committee
JV	Joint Venture
Kw	Kilowatt
LBE	Local Business Enterprise
MBE	Minority Business Enterprise
M/WBE	Minority and Woman-Owned Business Enterprise
ml	milliliter
mm	millimeter
NEC	National Electric Code
NEMA	National Electric Manufacturer's Association National Electrical Safety Code
NFPA	National Fire Protection Association
PM	Preventive Maintenance
PR	Proposal Request
RFI	Request for Information
RFS	Request for Substitution
SFM	State of California, Office of State Fire Marshal
CBC	California Building Code
CFC	California Fire Code
UL	Underwriters' Laboratories, Inc.
CMC	California Mechanical Code
CPC	California Plumbing Code
WOBE	Woman-Owned Business Enterprise
WMBE	Woman/Minority Business Enterprise

B. Additional abbreviations, used only on drawings, are listed thereon.

1.5 SYMBOLS

Symbols, used only on Drawings, are shown thereon.

1.6 DEFINITIONS

A. Wherever any of the words or phrases defined below, or a pronoun used in place thereof, is used in any part of the Contract Documents, it shall have the meaning here set forth:

ADDENDA: Written or graphic instruments issued prior to the opening of Bids, which clarify, correct or change the bidding requirements or the Contract Documents. Addenda shall not include the minutes of the Pre-bid Conference and Site Visit.

ADDITIVE BID: The sum to be added to the Base Bid if the change in scope of work as described in Additive Bid is accepted by CLPCCD.

AGREEMENT: Agreement is the basic contract document that binds the parties to construction Work. Agreement defines relationships and obligations between CLPCCD and Contractor and by reference incorporates Conditions of Contract, Drawings, and Specifications and contains Addenda and all Modifications subsequent to execution of Contract.

ALTERNATE: Work added to or deducted from the Base Bid, if accepted by CLPCCD.

APPROVED EQUAL: Approved in writing by CLPCCD as being of equivalent quality, utility and appearance.

ARCHITECT or ARCHITECT/ENGINEER: The person holding a valid California State Architect's license, whose firm has been designated within the Contract Documents as the Architect to provide architectural services on the project. Refer to Section 341, Part 1, Title 24, C. C. R.

When the Architect is referred to within the Contract Documents and no Architect has in fact been designated, then the matter shall be referred to CLPCCD. The term Architect shall be construed to include all its consultants retained for the project, as well as employees of the Architect. When the designated Architect is an employee of CLPCCD, his authorized representations on the project within the district will be included under the term Architect.

BID: The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

BIDDER: One who submits a Bid.

CLPCCD: Chabot-Las Positas Community College District. Unless otherwise expressly indicated or required by the context of usage, the terms "District" and "Owner" as used in the Contract Documents shall be deemed references to CLPCCD.

CLPCCD-FURNISHED, CONTRACTOR-INSTALLED: Items furnished by CLPCCD at its cost for installation by Contractor at its cost under this Contract.

CLPCCD REPRESENTATIVE(S): The person or persons assigned by CLPCCD to be CLPCCD's representatives or, if so designated, agent(s) at the site.

BY CLPCCD: Work that will be performed by CLPCCD or its agents at the CLPCCD's expense.

BY OTHERS: Work that is outside scope of Work to be performed by Contractor under this Contract, which will be performed by CLPCCD, other contractors, or other means.

CHANGE ORDER: A written instrument prepared by CLPCCD and signed by CLPCCD and Contractor, stating their agreement upon all of the following:

- a. a change in the Work,
- b. the amount of the adjustment in the Contract Sum, if any, and
- c. the amount of the adjustment in the Contract Time, if any.

As appropriate, change orders are subject to approval by the Division of the State Architect. Refer to section 4-338, Part 1, Title 24, California Code of Regulations.

CONCEALED: Work not exposed to view in the finished Work, including within or behind various construction elements.

CONTRACT CONDITIONS: Conditions of Contract define basic rights, responsibilities and relationships of Contractor and CLPCCD and consists of two parts: General Conditions and Supplementary Conditions.

- a. General Conditions are general clauses, which are common to the CLPCCD Contracts.
- b. Supplementary conditions modify or supplement General Conditions to meet specific requirements for this Contract.

CONSTRUCTION MANAGER: CLPCCD's authorized representative, who shall represent CLPCCD in all matters relative to this Contract. Construction Manager may authorize agents and representatives to act in carrying out Construction Manager's duties, including a "Project Manager", to act under the authority of the Construction Manager. As CLPCCD's agent, the Construction Manager is the beneficiary of all contract obligations of Contractor to CLPCCD, including without limitation, all releases and indemnities. Construction Manager shall not have any personal liability arising from this Contract or any activity there under and Contractor releases Construction Manager fully from all loss, cost, damage, expense or

liability arising out of or connected with this Project, whether arising from contract, negligence or tort claims of all kinds.

CONTRACT DOCUMENTS: Contract Documents shall consist of the documents identified as the Contract Documents in Contract Agreement, plus all changes, addenda and modifications thereto.

CONTRACT MODIFICATION: Either:

- a. a written amendment to Contract signed by Contractor and CLPCCD; or
- b. a Change Order; or
- c. a written directive for a minor change in the Work issued by CLPCCD.

CONTRACT SUM: The sum stated in the Agreement and, including authorized adjustments, the total amount payable by CLPCCD to Contractor for performance of the Work and the Contract Documents. (Also referred to as the CONTRACT PRICE.)

CONTRACT TIMES: The number or numbers of days or the dates stated in the Agreement (i) to achieve substantial completion of the Work or designated milestones and/or (ii) to complete the Work so that it is ready for final payment and is accepted.

CONTRACTOR: The person or entity identified as such in the Agreement and referred to throughout the Contract Documents as if singular in number and neuter in gender. The term "Contractor" means the Contractor or its authorized representative.

CONTRACTOR'S EMPLOYEES: Persons engaged in execution of Work under Contract as direct employees of Contractor, as subcontractors, or as employees of subcontractors.

DATE OF SUBSTANTIAL COMPLETION: Date of Substantial Completion of Work or designated portion thereof is date certified by Construction Manager when construction is sufficiently complete in accordance with Contract Documents for CLPCCD to occupy Work or designated portion thereof for its use for which it is intended.

DAY: One calendar day, unless the word "day" is specifically modified to the contrary.

DEDUCTIVE BID: The sum to be subtracting to the Base Bid if the change in scope of work as described in Deductive Bid is accepted by CLPCCD.

DEFECTIVE: An adjective which, when modifying the word "Work", refers to Work that is unsatisfactory or unsuited for the use intended, faulty, or deficient, that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents (including but not limited to approval of samples and "or equal" items), or has been damaged prior to final payment (unless responsibility for the protection thereof has been assumed by CLPCCD). Construction Manager is the judge of whether Work is defective.

DRAWINGS: The graphic and pictorial portions of Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

ENGINEER: Where referenced in the Contract Documents, the person holding a valid California State Engineer's license, whose firm has been designated (if any designated) within the Contract Documents as the Engineer to provide engineering services on the project. Refer to section 4-341, Part 1, Title 24, C.C.R.

EQUAL: Equal in opinion of Architect. Burden of proof of equality is responsibility of Contractor.

EXPOSED: Work exposed to view in the finished Work, including behind louvers, grilles, registers and various other construction elements.

FINAL ACCEPTANCE or FINAL COMPLETION: All Work satisfactorily completed in accordance with Contract Documents. It includes, but is not limited to:

- a. All Systems having been tested and accepted as having met requirements of Contract Documents.
- b. All required instructions and training sessions having been given by Contractor.
- c. All as-built drawings and operations and maintenance manuals and Machine Inventory Sheets having been submitted by Contractor, reviewed by Architect/Engineer and accepted by CLPCCD.
- d. All punch list work, as directed by CLPCCD, having been completed by Contractor.
- e. Generally all work, except Contractor maintenance after Final Acceptance, having been completed to satisfaction of CLPCCD.

FORCE-ACCOUNT: Work directed to be performed without prior agreement as to lump sum or unit price cost thereof, and which is to be billed at cost for labor, materials, equipment, taxes, and other costs, plus a specified percentage for overhead and profit.

FURNISH: Supply only, do not install.

INDICATED: Shown or noted on the Drawings.

INSPECTOR: The person engaged by CLPCCD to inspect the workmanship, materials, or manner of construction of buildings or portions of buildings, to determine if such construction complies with the Contract Documents and applicable codes. The inspector is subject to approval by the Architect, CLPCCD and, as appropriate, Division of the State Architect, and he will report to CLPCCD. Refer to section 4-333 and section 4-342, Part 1, Title 24, California Code of Regulations. The terms "Inspector" and "Project Inspector" are used interchangeably in the Contract Documents.

INSTALL: Install or apply only, do not furnish.

LATENT: Not apparent by reasonable inspection, including but not limited to, the inspections and research required as a condition to bidding under the General Conditions.

MATERIAL OR MATERIALS: These words shall be construed to embrace machinery, manufactured articles, materials of construction (fabricated or otherwise), and any other classes of material to be furnished in connection with Contract, except where a more limited meaning is indicated by context.

MILESTONE: A principal event specified in Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all Work.

MODIFICATION: Same as Contract Modification.

NOT IN CONTRACT: Work that is outside the scope of work to be performed by Contractor under this Contract.

NOTICE OF AWARD: A written notice given by CLPCCD to lowest responsive, responsible bidder advising that Bidder's bid and other qualifying information is acceptable to CLPCCD, requiring Bidder to fulfill the requirements of Article 1.03 of Document 00600 General Conditions.

NOTICE TO PROCEED: A written notice given by CLPCCD to Contractor fixing the date on which the Contract Time will commence to run and on which contractor shall start to perform Contractor's obligations under the Contract Documents.

OFF SITE: Outside geographical location of the Project.

OWNER: Chabot Las Positas Community College District (CLPCCD).

PROGRESS REPORT: a periodic report submitted by Contractor to CLPCCD with progress payment invoices accompanying actual work accomplished to the Project Schedule. See Section 01310 Progress Schedules and Reports, Document 00600 General Conditions.

PROJECT: Total construction of which Work performed under this Contract may be whole or part.

PROJECT MANUAL: Project Manual consists of Bidding Requirements, Agreement, Bonds, Certificates, Contract Conditions, and Specifications. The Project Manual is deemed to include and incorporate all matters noted in any Addenda issued by or on behalf of the District during the bidding for the Work.

PROJECT STABILIZATION AGREEMENT: The Contractor or Subcontractor (CONTRACTOR) on this project accepts and agrees to be bound by the terms and conditions of the "Chabot-Las Positas Project Stabilization Agreement", together with any and all amendments and supplements now existing or which are later made by executing the Letter of Assent.

PROVIDE: Furnish and install.

REQUEST FOR INFORMATION (RFI): A document prepared by Contractor, CLPCCD or Architect/Engineer requesting information from one of the parties regarding the Project or Contract Documents. The RFI system is also a means for CLPCCD and Architect to submit Contract Document clarifications or supplements to Contractor.

RFI-REPLY: A document consisting of supplementary details, instructions or information issued by the Architect/Engineer, which clarifies or supplements Contract Documents and with which Contractor shall comply. RFI-Replies do not constitute changes in Contract Sum or Contract Times except as otherwise agreed in writing by CLPCCD. RFI-Replies will be issued through the RFI administrative system.

SAMPLES: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

SHOP DRAWINGS: All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the work.

SHOWN: As indicated on Drawings.

SITE: The particular geographical location of Work performed pursuant to Contract, including staging areas, work areas, storage and lay down areas, access and parking.

SPECIFICATIONS: The written portion of the Contract Documents consisting of requirements for materials, equipment, construction systems, standards and workmanship

for the Work, and performance of related services; and are contained in Divisions 1 through 32.

SPECIFIED: As written in Specifications.

SUBCONTRACTOR: A person or entity who has a direct contract with Contractor to perform a portion of the Work at the site. The term "subcontractor" is referred to throughout the Contract Documents as if singular in number and neuter in gender and means a subcontractor or an authorized representative of the subcontractor. The term "subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

SUBSTANTIAL COMPLETION: The Work (or a specified part thereof) has progressed to the point where, in the opinion of the Construction Manager and the Architect/Engineer as evidenced by a Certificate of Substantial Completion, it is sufficiently complete, in accordance with Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment is evidenced by written recommendation of the Construction Manager and the Architect/Engineer for final payment. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

SUPPLEMENTAL INSTRUCTION: A written work change directive to Contractor from Architect/Engineer, approved by Construction Manager, ordering alterations or modifications which do not result in change in Contract Sum or Contract Times, and do not substantially change Drawings or Specifications.

UNDERGROUND FACILITIES: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: Electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

VERIFIED REPORT: A periodic verified report submitted to DSA. Refer to sections 4-336, 4-337 and 4-343, Part 1, Title 24, California Code of Regulations.

WORK: The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all is required by the Contract Documents. Wherever the word "work" is used, rather than the word "Work", it shall be understood to have its ordinary and customary meaning.

- B. Wherever words "as directed", "as required", "as permitted", or words of like effect are used, it shall be understood that direction, requirements, or permission of CLPCCD or Construction Manager is intended. Words "sufficient", "necessary", "proper", and the like shall mean sufficient, necessary or proper in judgment of CLPCCD or Construction Manager. Words "approved", "acceptable", "satisfactory", "favorably reviewed" or words of like import, shall mean approved by, or acceptable to, or satisfactory to, or favorably reviewed by CLPCCD or Construction Manager.
- C. Wherever the word "may" is used, the action to which it refers is discretionary. Wherever the word "shall" is used, the action to which it refers is mandatory.

PART 2 – PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END OF SECTION

SECTION 01 4500

QUALITY CONTROL

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. References.
- C. Mock-Up.
- D. Inspection and testing laboratory services.
- E. Manufacturer's field services.

1.2 RELATED SECTIONS

- A. Submission of manufacturers' instructions and
- B. Sections requiring Laboratory Testing:
 - 1. Section 01 3300 - Submittals: certificates
 - 2. Division 31 - Earthwork
 - 3. Section 32 1233 – Paving and Resurfacing
 - 4. Section 32 1313 - Site Concrete Paving Section
 - 5. Section 03 3000 - Cast-in-Place Concrete
 - 6. Section 04 2200 - Concrete Unit Masonry
 - 7. Section 05 1200 - Structural Steel Framing
 - 8. Section 05 5000 - Metal Fabrications

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. If manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 REFERENCES

- A. Conform to reference standard by date of issue current on date specified in product sections.
- B. Should specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 MOCK-UP

- A. Mock-up and sample panels will be performed under various sections and identified as sample panels or mock-ups.
- B. Assemble and erect specified items with specified attachments, anchorage, flashing, seals and finishes.
- C. Where mock-up has been accepted by Architect/Engineer and is specified in product specification section to be removed, remove mock-up and clear area as directed.
- D. Whereas, mock-up submittals will be submitted until the acceptance by Architect/Engineer and Construction Manager.

1.6 INSPECTION AND TESTING LABORATORY SERVICES

- A. CLPCCD will appoint, employ and pay for services of an independent firm to perform inspection and testing.
- B. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Architect/Engineer. Promptly notify Construction Manager, Architect/Engineer, DSA, Project Inspector, and Contractor of observed irregularities or deficiencies of work or products.
- C. Reports will be submitted by the independent firm, one copy each, to the Construction Manager, Architect, Engineer, Division of the State Architect, Contractor and Project Inspector. Indicate observations and results of tests and indicate compliance or non-compliance with Contract Documents and Title 24, C.C.R. specifically, each report will include the following:
 - 1. Date issued; date and time of sampling or inspection; date of test.
 - 2. Project title and number; testing laboratory name, address and telephone number; name and signature of laboratory inspector.
 - 3. Location of sampling or test; temperature and weather condition.
 - 4. Type of inspection or test; identification of product and specification section; results of test and compliance with Contract Documents and Title 24, C.C.R.
 - 5. Perform additional tests as required by Architect/Engineer and/or Project Inspector; interpret test results, when requested by Architect/Engineer.
 - 6. Special Inspections: as shown on attached Tests & Inspections (T&I) list for each section.
- D. Contractor shall cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - 1. Notify Architect/Engineer 72 hours in advance and/or independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
 - 3. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the work of the contract.
- E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer and/or Project Inspector. Payment for retesting will be paid by the Contractor by deducting inspection or testing charges from the Contract Sum on the next scheduled payment.

1.7 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Construction Manager thirty (30) calendar days in advance of required observations. Observer shall be subject to approval of Construction Manager and Architect/Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00 - Submittals: Manufacturers' Instructions.

PART 2 – PRODUCTS

Not applicable to this section.

PART 3 – EXECUTION

Not applicable to this section.

END OF SECTION

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SECTION 01 4520
CONCRETE MOISTURE TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Testing for Moisture Vapor Emission Rate (MVER) and alkalinity at concrete floors scheduled to receive applied floor coverings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 INFORMATIONAL SUBMITTALS

- A. Qualifications of personnel or laboratory to perform testing.
- B. Results of substrate moisture testing for each location and maximum allowable levels specified in respective Specification Sections for the intended floor finish.

1.4 QUALITY ASSURANCE

- A. If areas of concrete are not within the floor covering manufacturer's maximum allowable emission rate and slab area fails the moisture test, do not proceed with installation and notify the Architect.

1.5 FIELD CONDITIONS

- A. Ambient Conditions:
1. Area to be tested shall match that of the finished floor covering.
 2. Spaces shall be conditioned to temperature and humidity levels expected for final user occupancy or as follows:
 - a. Interior temperature shall be 75 degrees F, plus or minus 10 degrees F.
 - b. Relative humidity shall be 50 percent, plus or minus 10 percent.
 3. Maintain the above conditions for 48 hours prior to and throughout the duration of the tests.

PART 2 - PRODUCTS

2.1 MATERIALS FOR TEST PROCEDURES

- A. MVER Tests:
1. Calcium Chloride Test Kits: Pre-packaged and of commercial consistency; American Moisture Test, Inc., Irvine, CA, Taylor Tools, or accepted equal. Kit shall include sealed dish of anhydrous calcium chloride, a metering dome with gasket, and instructions.
 2. Relative humidity (RH) probe that has been verified for accuracy within the past year.
- B. Alkalinity Tests: Test kit by American Moisture Test, Inc., Irvine, CA, Taylor Tools, or accepted equal pH meter.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean concrete surfaces of any residues resulting from pour of concrete which will affect the moisture vapor drive.
- B. Plastic dome of test kit shall be sealed airtight to prevent ambient humidity from influencing the test results.

3.2 TESTING

- A. General:
 - 1. Perform moisture tests based on the Moisture Vapor Emission Rate (MVER) content in accordance with ASTM F1869, relative humidity tests in accordance with ASTM F2170, and alkalinity tests in accordance with ASTM F710, on concrete subfloors. Results of these tests will be used to determine suitability of substrate to receive flooring materials.
 - 2. Number of tests shall be determined by the square footage of each flooring material. Provide minimum of three tests for the first 1,000 square feet (93 square meters), and one test kit per each additional 1,000 square feet (93 square meters), with consideration to separation of test areas.
 - 3. Results of these tests will be used to determine suitability of substrate to receive flooring materials.
- B. MVER Test Kit:
 - 1. Verify temperature of slab is up to service temperature.
 - 2. Duration of MVER test shall be 60 to 72 hours.
 - 3. Dish shall be measured one-hour before and one-hour after testing with weight calculated within 0.1 grams.
 - 4. Where calcium chloride test results are satisfactory but there is reason to suspect that unacceptable moisture levels below the upper two centimeters of the concrete may still exist, a relative humidity probe shall be used to test the full depth of the slab.
- C. RH Probe:
 - 1. Verify concrete slabs are up to service temperature at least 48 hours prior to testing.
 - 2. Depth of probes shall be 40 percent on slabs drying from the top only and 20 percent for slabs drying from both sides.
 - 3. Probe shall be allowed to acclimate and checked for drift less than 1 percent relative humidity over a 5 minute period.
 - 4. Elapsed time for test shall be 48 hours.
- D. Where tests are not satisfactory and substrates exceed the moisture vapor and alkalinity limits required by floor material manufacturers, do not proceed with installation.
- E. Contractor shall notify District's Representative for review of conditions and to determine a resolution acceptable to the District including application of a topical barrier coat as specified in Section 07 2620, "Concrete Vapor Emission Control."

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES

PART 1 GENERAL

1.1 SUMMARY

This section describes the temporary facilities required for the Project site. The Project site shall be maintained by Contractor as set forth in this section.

1.2 TEMPORARY FACILITIES

- A Contractor shall obtain permits for, install and maintain in safe condition, whatever scaffolds, hoisting equipment, barricades, walkways, or other temporary structures, which may be required to accomplish the work on the Project. Contractor shall enclose and secure Project Site, including lay down area with a temporary chain link fence. Such structures shall be adequate for the intended use and capable of safely accepting all loads that may be imposed upon them. They shall be installed and maintained in accordance with all applicable State and local codes and regulations.
- B. Contractor shall provide and maintain temporary heat from an approved source whenever in the course of the Work it may become necessary for curing and drying of materials or to warm spaces as may be required for the installation of materials or finishes.
- C. Contractor shall provide and maintain any and all facilities that may be required for dewatering in order that work may proceed on the Project. If it is necessary for dewatering to occur continually, Contractor shall have on hand whatever spare parts or equipment that may be required to prevent interruption of dewatering.
- D. Contractor shall provide and maintain all utility services necessary to perform the work under this Contract. These may include, but are not limited to, temporary electricity, water, gas, sewer and telephone, including charges and installation fees. Contractor shall furnish and maintain all means of distribution of utility services required within the site to properly complete the Project.
- E. Materials, tools, accessories, etc., shall be stored only where directed by CLPCCD. Storage area shall be kept neat and clean. Security of stored items shall be Contractor's responsibility.
- F. When flammable materials are stored on site, extra precautions, including clear identification, shall be the responsibility of Contractor.
- G. Contractor shall provide and maintain temporary toilets in quantities and locations as required by CAL/OSHA and other local codes and regulations. They shall be maintained and supplied in a usable and sanitary condition at all times.
- H. If water at construction site is determined to be non-potable by Inspector, Contractor shall provide and maintain adequate potable water stations at site until final completion of the Project.
- I. Contractor shall maintain an office at the Project site, which will be his headquarters for the Project. Any communications delivered to this office shall be considered as delivered to Contractor. Location and size of office shall be such that it will adequately serve the needs of Contractor's superintendent and assistants in the performance of their duties.
- J. Contractor shall also provide and maintain the following temporary facilities for the duration of the project. Contractor shall obtain approval of the plans and specifications for all the following temporary facilities from Construction Manager prior to delivery to job site. Construction Manager shall have the option to reject said facilities if they do not meet Construction Manager's needs.

1. **Facilities/Services for the Project Inspector.** The Contractor shall provide, without adjustment of the Contract Price, for use by the Project Inspector, facilities, equipment, furnishings, and services set forth in the Special Conditions.

K. Contractor shall promptly remove all such Temporary Facilities when they are no longer needed for the work or for completion of the Project, mutually agreed upon by Contractor and CLPCCD.

L. Contractor shall provide and maintain in the Temporary Facilities a copy of the California Code of Regulations Title 24 (latest edition) Parts I & II.

1.3 SIGNS

No signs may be displayed on or about CLPCCD's property (except those required by law) without CLPCCD's specific approval; the size, content, and location to be as specified by CLPCCD.

1.4 USE OF ROADWAYS AND WALKWAYS

Contractor shall never block or interfere with use of any existing roadway, walkway or other facility for vehicular or pedestrian traffic, from any party entitled to use it. Wherever and whenever such interference becomes necessary for the proper and convenient performance of the Work, and no satisfactory detour route exists, Contractor shall, before beginning the interference, provide a satisfactory detour, including temporary bridge if necessary, or other proper facility for traffic to pass around or over the interference. Contractor shall maintain the detour in a safe and satisfactory condition as long as the interference continues, all without extra payment unless otherwise expressly stipulated in the Specifications.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

Not used.

END OF SECTION

SECTION 01 5639

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protect existing trees and plants scheduled to remain against injury or damage, including cutting, breaking, or skinning of roots, trunks or branches; soil compaction by stockpiled construction materials, excavated materials or vehicular traffic within the dripline (tree canopy). The work includes but is not limited to the following:
 - 2. Protecting existing trees and plants to remain during all phases of construction, including site preparation, excavation, and trenching.
 - 3. Erection, maintenance, and removal of temporary tree protection fencing.
 - 4. Replacement of trees and plants damaged by work of this Contract.
- B. Related Sections include the following
 - 1. All Division 31, 32, and 33 Sections

1.3 REFERENCES AND STANDARDS

- A. American National Standard for Tree Care Operations; ANSI Z133.1-1988, International Society of Arboriculture (ISA).
- B. Cooperative Extension U.C., Leaflet 21418, "Tree Evaluation and Casualty Loss".

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the above-named references and standards.
- B. Perform all arboricultural and related soil work under the observation of the Owner's Representative and/or an International Society of Arboriculture (ISA) Certified Arborist designated by the Owner.

1.5 PROJECT CONDITIONS

- A. Perform specified tree protection work before commencing site preparation, excavation, trenching and construction.
- B. Prior to commencing work, meet with the Owner's Representative and identify and mark all existing trees that are within the construction zone and are likely to require protection measures as herein specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Tree Protection Fencing:
 - 1. Polyethylene Safety Fencing; 48"width; 1 2" mesh opening; color orange; tensile strength 2000 to 2310 psi.
 - 2. Posts: 2x4 Douglas Fir or heavy duty punched metal "U" posts; 13 gauge steel.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING TREES AND PLANTS

- A. Tree and Plant Protection Fencing:
 - 1. Protect designated trees and plants with a temporary 4'-0" high Safety Fence enclosure.
 - 2. Locate fencing as follows:
 - a. Tree Masses: around entire tree mass at the dripline (edge of tree canopy).
 - b. Single Trees: around drip line of tree.
 - 3. Erect temporary fencing before commencing any construction work. Maintain fencing during full construction period. Remove temporary fencing when no longer needed or when acceptable to Owner's Representative.
 - 4. Obtain approval by the Owner's Representative of proposed fencing alignment prior to installation.
- B. Vehicles, materials storage and excavated materials are not allowed within the fenced areas and/or tree driplines.
 - 1. If access is determined to be necessary, apply a 4-inch deep layer of approved bark mulch over the required area.
 - 2. If equipment access is required, place interlocking metal matting on top of the bark mulch.
- C. Trenching and Excavation:
 - 1. Mechanical Trenching may be done outside the drip line of a tree or to within 1/3 of the tree's height, whichever is greater.
 - 2. Hand trenching is required inside the tree's drip line or within the 1/3 height zone.
- D. Root Treatment:
 - 1. Leave large roots exposed during excavation intact if possible, by hand excavating around the root; this is a requirement for roots 4" in diameter and larger.
 - 2. All roots 1" in diameter and larger that require cutting shall be cut cleanly and obliquely with surfaces facing downward.
 - a. Moisten roots and surrounding soil and cover with a 4" thick layer of bark mulch to prevent desiccation.
 - b. Do not apply pruning seals or paint to the wounds.
 - c. Protect cut and exposed roots from drying. Drape a water absorbent material (burlap) from top of trench, covering roots; keep moist until soil backfill is replaced.
- E. Pruning Requirements:
 - 1. Obtain the approval of the Owner's Representative for any pruning of trees required for construction clearance.
 - 2. All pruning work shall be performed by an ISA Certified Arborist or Tree Worker. All work shall be done in accordance with pruning techniques adopted by ISA.
- F. Tree and Plant Repair:

1. Promptly repair trees and plants scheduled to remain and damaged by construction operations in a manner acceptable to the Owner's Representative. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
 2. All repair work shall be performed by an ISA Certified Arborist or Tree Worker. All work shall be done in accordance with techniques adopted by ISA.
- G. Tree and Plant Replacement:
1. Replace trees scheduled to remain that are damaged beyond repair by construction operations, as determined by the Owner's Representative, with trees of similar size and species, or by payment of an amount representing the value of the damaged material as determined by the Owner in accordance with Cooperative Extension U.C., Leaflet 21418, "Tree Evaluation and Casualty Loss."
- H. Repair and replacement of trees and plants scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at Contractor's expense.

END OF SECTION

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SECTION 01 6100

MATERIAL AND EQUIPMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Products
- B. Transportation and handling.
- C. Storage and protection.

1.2 RELATED SECTIONS

- A. Section 01 1100 - Summary of Work.
- B. Section 01 4500 - Quality Control: Product Quality Monitoring.

1.3 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
- B. Provide interchangeable components of the same manufacturer, for similar components.

1.4 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions and construction schedules. Coordinate to avoid conflict with work and conditions at the site.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.5 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated products, place on sloped supports, above ground, to prevent soiling and staining.
- C. Provide off-site storage and protection when site does not permit on-site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- H. Provide substantial covering and protection after installation of products from damage due to traffic and subsequent construction operations. Remove when no longer needed.

PART 2–PRODUCTS

Not applicable to this section.

PART 3–EXECUTION

Not applicable to this section.

END OF SECTION

SECTION 01 6200
PRODUCT OPTIONS & SUBSTITUTIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. Procedures are described for selecting products and requesting substitutions of unlisted materials in lieu of materials named in the specifications or approved for use in addenda.
- B. Related Sections
 - 1. Section 01 2600: Contract Modification Procedures
 - 2. Section 01 3300: Submittals

1.2 CONTRACTOR'S OPTIONS

- A. For products specified only by reference standard: Select any product meeting that standard.
- B. For products specified by naming one or more products or manufacturers:
 - 1. Select products of any named manufacturer meeting specifications.
 - 2. For any product or manufacturer, which is not specifically named, submit Request for Substitution (RFS).
- C. For products indicated or specified by naming only one product and manufacturer, followed by the words "no substitution allowed", there is no option.

1.3 SUBSTITUTIONS

- A. No substitutions shall be allowed for District standard systems, products, and/or materials unless approved in writing from the Architect's office five (5) days prior to bid.
- B. Within a period of thirty-five (35) days after Award of Contract, Construction Manager and Architect/Engineer will consider RFS from Contractor. After that period, requests will be considered only when product becomes unavailable due to no fault of Contractor. Requests for review of proposed substitute items will not be accepted from anyone other than Contractor. The RFS will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor's achievement of substantial completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with CLPCCD for work on the Project).
- C. Submit separate RFS for each product and support each request with:
 - 1. Product identification
 - 2. Manufacturer's literature
 - 3. Samples, as applicable
 - 4. Name and address of similar projects on which product has been used, and date of installation
 - 5. Name, address and telephone number of manufacturer's representative or sales engineer
 - 6. Where DSA approval is required, product shall be reviewed and approved by DSA
- D. Itemize a comparison of the proposed substitution with product specified and list significant variations. If variation from product specified is not pointed out in submittal, variation will be rejected even though submittal was favorably reviewed.
- E. State whether the substitute will require a change in any of the Contract documents (or provisions of any other direct contract with CLPCCD for work on the Project) to adapt the design of the proposed substitute, and whether or not incorporation or use of the substitute in connection with Work is subject to payment of any license fee or royalty. Submit data relating to changes in construction schedule.

- F. All variations of the proposed substitute from that specified will be identified in the RFS and available maintenance, repair and replacement service will be indicated.
- G. Include accurate cost data comparing proposed substitution with product and amount of net change in Contract price, including but not limited to, an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors effected by the resulting change, all of which will be considered by Construction Manager and Architect/Engineer in evaluating the proposed substitute. Construction Manager and Architect/Engineer may require Contractor to furnish additional data about the proposed substitute.
- H. Substitutions will not be considered for acceptance when:
 - 1. They will result in delay meeting construction milestones or completion dates.
 - 2. They are indicated or implied on submittals without formal request from Contractor.
 - 3. They are requested directly by subcontractor or supplier.
 - 4. Acceptance will require substantial revision of Contract Documents.
 - 5. They disrupt Contractor's job rhythm or ability to perform efficiently.
- I. Substitute products shall not be ordered without written acceptance of Construction Manager and Architect/Engineer.
- J. Construction Manager and Architect/Engineer will determine acceptability of proposed substitutions and reserve right to reject proposals due to insufficient information.
- K. Accepted substitutions will be evidenced by a change order or Supplemental Instruction. All Contract requirements apply to Work involving substitutions.

1.4 CONTRACTOR'S REPRESENTATION AND WARRANTY

- A. Requests constitute a representation and warranty that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product
 - 2. Will provide the same warranty for substitution as for specified product
 - 3. Will coordinate installation and make other changes, which may be required for Work to be complete in all respects
 - 4. Waives claims for additional costs, which may subsequently become apparent
 - 5. Will compensate CLPCCD for additional redesign costs associated with substitution, if required
 - 6. Will be responsible for Construction Schedule slippage due to substitution
 - 7. Will be responsible for Construction Schedule delay due to late ordering of available specified products caused by requests for substitution, which is subsequently rejected by Construction Manager
 - 8. Will compensate CLPCCD for all costs; including extra costs of Contract, extra cost to other contractors, and any claims brought against CLPCCD, caused by late requests for substitutions or late ordering of products.

1.5 CONSTRUCTION MANAGER'S AND ARCHITECT/ENGINEER'S DUTIES

- A. Review Contractor's RFS within seven (7) working days.
- B. Notify Contractor in writing of decision to accept or reject requested substitution within seven (7) working days.

1.6 COST OF REVIEW

- A. Construction Manager and Engineer will record time required in evaluating substitutes proposed or submitted by Contractor. Whether or not Construction Manager or Architect/Engineer accepts the substitute item so proposed or submitted by Contractor, Contractor shall reimburse CLPCCD for the charges of Architect/Engineer and Construction Manager for evaluating each such proposed substitute item.

- B. The CLPCCD reserves the right to waive the requirement of paragraph A above.

PART 2–PRODUCTS

Not used.

PART 3–EXECUTION

Not used.

END OF SECTION

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SECTION 01 7000
CONTRACT CLOSEOUT

PART 1 – GENERAL

1.1 SUMMARY

This section describes contract closeout procedures including:

1. Removal of temporary construction facilities
2. Substantial completion
3. Final completion
4. Final cleaning
5. Project record documents
6. Material, equipment and finish data
7. Project guarantee
8. Warranties
9. Turn-in
10. Release of claims
11. Guaranty and Maintenance Bonds

1.2 REMOVAL OF TEMPORARY CONSTRUCTION FACILITIES

- A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion Inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Restore permanent facilities used during construction to specified condition.

1.3 SUBSTANTIAL COMPLETION

- A. When Contractor considers Work or designated portion thereof as substantially complete, submit written notice, with list of items to be completed or corrected to Construction Manager.
- B. Within reasonable time, Construction Manager and Architect/Engineer will inspect to determine status of completion.
- C. Should Construction Manager or Architect/Engineer determine that Work is not substantially complete; Construction Manager will promptly notify Contractor in writing, listing all defects and omissions.
- D. Remedy deficiencies and send a second written notice of substantial completion. Architect/Engineer will reinspect the Work. If deficiencies previously noted are not corrected on reinspection, then Contractor shall pay the cost of the reinspection.
- E. When Architect/Engineer determines that Work is substantially complete, Construction Manager will issue a Certificate of Substantial Completion.
- F. Manufactured units, equipment and systems, which require startup, must have been started up and run for periods prescribed by Construction Manager, Architect/Engineer, or Owner before a Certificate of Substantial Completion will be issued.

1.4 FINAL COMPLETION

- A. When Contractor considers Work is complete, submit written certification that:
 - 1. Contractor has inspected Work for compliance with Contract Documents.
 - 2. Work, except for Contractor maintenance after Final Acceptance, has been completed in accordance with Contract Documents and deficiencies listed with Certificate of Substantial Completion have been corrected.
 - 3. Work is complete and ready for final inspection.
 - 4. Contractor has achieved all requirements for Final Acceptance as that term is defined in Section 01 41 00 – Regulatory Requirements.
- B. In addition to submittals required by conditions of Contract, provide submittals required by governing authorities and submit final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.
- C. When Architect/Engineer finds Work is acceptable and final submittal is complete, Construction Manager will issue final change order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.5 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
 - 1. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment operated during construction, clean ducts, blowers and coils of units operated without filters during construction.
 - 2. Employ skilled workers for final cleaning.
- C. Clean Site; mechanically sweep-paved areas.
- D. Remove waste and surplus materials, rubbish, and construction facilities from Site.

1.6 PROJECT RECORD DOCUMENTS

- A. General
 - 1. Project Record Documents required include:
 - a. Marked-up copies of Contract Drawings
 - b. Marked-up copies of Shop Drawings
 - c. Newly prepared Drawings
 - d. Marked-up copies of Specifications, Addenda and Change Orders
 - e. Marked-up Project Data submittals
 - f. Record Samples
 - g. Field records for variable and concealed conditions
 - h. Record information on Work that is recorded only schematically
 - i. Comments to all required DSA documentation
 - j. All approved change orders
 - 2. Specific Project Record Documents requirements that expand requirements of this Section are included in the individual Sections of Divisions 2 through 33.
 - 3. Maintenance of Documents and Samples:
 - a. Store Project Record Documents and samples in the field office apart from Contract Documents used for construction.
 - b. Do not permit Project Record Documents to be used for construction purposes.
 - c. Maintain Project Record Documents in good order, and in a clean, dry, legible condition.
 - d. Make documents and samples available at all times for inspection by Architect/Engineer.

4. CLPCCD will provide one set of sepias and one blueline set of the construction drawings and one-project manuals for the Contractor's use and copying during construction.
- B. Project Record Drawings
1. Mark-up Procedure: During the construction period, maintain a set of blueline or blackline prints of Contract Drawings and Shop Drawings for Project Record Document purposes.
 2. Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements, which would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to:
 - a. Dimensional changes to the building
 - b. Drawings Revisions to details shown on the Contract Drawings
 - c. Drawings Depths of foundations below the first floor
 - d. Locations and depths of underground utilities
 - e. Revisions to routing of piping and conduits
 - f. Revisions to electrical circuitry
 - g. Actual equipment locations
 - h. Duct size and routing
 - i. Locations of concealed internal utilities
 - j. Changes made by Change Order
 - k. Details not on original Contract Drawings
 3. Mark completely and accurately Project Record Drawing prints of Contract Drawings or Shop Drawings, whichever is the most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
 4. Mark Project Record Drawing sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.
 5. Mark important additional information, which was either shown schematically or omitted from original Drawings.
 6. Note construction change directive numbers; alternate numbers; Change Order numbers and similar identification.
 7. Responsibility for Mark-up: Where feasible, the individual or entity who obtained Project Record Drawing data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on Project Record Drawings.
 - a. Accurately record information in an understandable and legible drawing technique.
 - b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
 8. At time of Substantial Completion, submit Project Record Drawings to Construction Manager for CLPCCD's records. Organize into sets, bind and label sets for CLPCCD's continued use.
 9. All record documents shall be submitted in an electronic format and hard copy.
- C. Preparation of Documents: Immediately prior to inspection for Certification of Substantial Completion, review completed marked-up Project Record Drawings with the Architect/Engineer. When authorized, prepare a full set of correct Contract Drawings and Shop Drawings.
1. Incorporate changes and additional information previously marked on print sets. Erase, redraw, and add details and notations where applicable. Identify and date each Drawing; include the printed designation "PROJECT RECORD DRAWINGS" in a prominent location on each Drawing.
 2. Refer instances of uncertainty to the Architect/Engineer for resolution.
 3. Review of Documents: Before copying and distributing, submit corrected drawings and the original marked-up prints to the Architect/Engineer for review. When acceptable, the Architect/Engineer will initial and date each document, indicating acceptance of

- general scope of changes and additional information recorded, and of the quality of drafting.
- a. Documents and the original marked-up prints will be returned to the Contractor for organizing into sets, printing, binding, and final submittal.
- D. Copies and Distribution: After completing the preparation of Project Record Drawings, print three (3) blue-line or black-line prints of each Drawing, whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with durable paper cover sheets, with appropriate identification, including titles, dates and other information on cover sheets.
1. Organize and bind original marked-up set of prints that were maintained during the construction period in the same manner.
 2. Organize Project Record Drawings into sets matching the print sets. Place these sets in durable tube-type drawing containers with end caps. Mark the end cap of each container with suitable identification.
 3. Submit the marked-up Project Record Drawings set and three (3) copy sets to the Construction Manager for CLPCCD's records; the Architect/Engineer will retain one copy set.
- E. PROJECT RECORD SPECIFICATIONS
During the construction period, maintain one copy of the Project Specifications, including addenda and modifications issued, for Project Record Document purposes.
1. Mark the Project Record Specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and Modifications issued. Note related Project Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installation that would be difficult to identify or measure and record later.
 - a. In each Specification Section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
 - b. Record the name of the manufacturer, supplier and installer, and other information necessary to provide a record of selections made and to document coordination with Project Record Product Data submittals and maintenance manuals.
 - c. Note related Project Record Product Data, where applicable, for each principal product specified, indicate whether Project Record Product Data has been submitted in maintenance manual instead of submitted as Project Record Product Data.
 2. Upon completion of mark-up, submit Project Record Specifications to the Construction Manager for CLPCCD's records.
- F. PROJECT RECORD PRODUCT DATA. During the construction period, maintain one copy of each Project Record Product Data submittal for Project Record Document purposes.
1. Mark Project Record Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Project Record Product Data submitted. Include significant changes in the product delivered to the site, and changes in manufacturer's instructions and recommendations for installation.
 2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 3. Note related Change Orders and mark-up of Project Record Drawings, where applicable.
 4. Upon completion of mark-up, submit a complete set of Project Record Product Data to the Construction Manager for CLPCCD's records.
 5. Where Project Record Product Data is required as part of maintenance manuals, submit marked-up Project Record Product Data as an insert in the manual, instead of submittal as Project Record Product Data.

6. Each prime Contractor is responsible for mark-up and submittal of record Project Record Product Data for its own Work.
- G. MATERIAL, EQUIPMENT AND FINISH DATA.
1. Provide data for primary materials, equipment and finishes as required under each specification section.
 2. Submit two (2) sets prior to final inspection, bound in 8-1/2 inches by 11 inches three-ring binders with durable plastic covers; provide typewritten table of contents for each volume.
 3. Arrange by Specification division and give names, addresses, and telephone numbers of subcontractors and suppliers. List:
 - a. Trade names
 - b. Model or type numbers
 - c. Assembly diagrams
 - d. Operating instructions
 - e. Cleaning instructions
 - f. Maintenance instructions
 - g. Recommended spare parts
 - h. Product data
- H. FINAL AS-BUILT DRAWINGS, SPECIFICATIONS.
1. As-Built Drawings and Specifications are the official record drawing that documents what was constructed
 2. These drawings shall be available to the Architect and shall be provided to the District upon completion of the of the work.
 3. Requirements:
 - a. One hard copy set of full size (24x36) or (36x48) As-Built Plans, with DSA App #, and "AS BUILT" stamped on each sheet in red.
 - b. One hard copy set of half size As-Built Plans, with DSA App #, and "AS BUILT" stamped on each sheet in red.
 - c. One hard copy set of specifications with "AS BUILT" stamped on the cover page in red.
 - d. A CD/DVD in PDF and CAD formats (CAD format to be compatible with AutoCAD 2016) with the following naming convention for the CD/DVD cover:
 - 1) College Name
 - 2) Project Name
 - 3) DSA Application #
 - 4) Do not check the "read only" option
 - 5) Do not password protect any files

1.8 MISCELLANEOUS PROJECT RECORD SUBMITTALS

Refer to other Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Construction Manager for CLPCCD's records.

Categories of requirements resulting in miscellaneous records include, but are not limited to the following:

- a. Field records on excavations and foundations
- b. Field records on underground construction and similar work
- c. Survey showing locations and elevations of underground lines
- d. Invert elevations of drainage piping
- e. Surveys establishing building lines and levels
- f. Authorized measurements utilizing unit prices or allowances
- g. Records of plant treatment
- h. Ambient and substrate condition tests

- i. Certifications received in lieu of labels on bulk products
- j. Batch mixing and bulk delivery records
- k. Testing and qualification of tradespersons
- l. Documented qualification of installation firms
- m. load and performance testing
- n. Inspections and certifications by governing authorities leakage and water-penetration tests
- o. Fire resistance and flame spread test results
- p. Final inspection and correction procedures

1.9 PROJECT GUARANTEE

- A. Neither recordation of final acceptance nor final certificate for neither payment nor provision of the Contract nor partial or entire use or occupancy of the Site by CLPCCD shall constitute acceptance of Work not done in accordance with Contract Documents nor relieve Contractor of liability in respect to express warranties or responsibility for faulty materials or workmanship.
- B. Requirements for Contractor's guarantee of completed Work are included in General Conditions, Article 1.09. Contractor shall guarantee Work done under Contract against failures, leaks or breaks or other unsatisfactory conditions due to defective equipment, materials or workmanship, and perform repair work or replacement required, at Contractor's sole expense, for period of 2 years from date of Final Acceptance, as required by paragraph 13.2 of General Conditions.
- C. CLPCCD may make repairs to defective Work as set forth in paragraph 12.6 of General Conditions, if, within 5 working days after mailing of written notice of defective work to Contractor or authorized agent, Contractor shall neglect to make or undertake with due diligence repairs; provided, however, that in case of leak or emergency where, in opinion of CLPCCD, delay would cause hazard to health or serious loss or damage, repairs may be made without notice being sent to Contractor, and Contractor shall pay cost thereof.
- D. If, after installation, operation or use of materials or equipment to be furnished under Contract proves to be unsatisfactory to Construction Manager, CLPCCD shall have right to operate and use materials or equipment until it can, without damage to CLPCCD, be taken out of service for correction or replacement. Period of use of defective materials or equipment pending correction or replacement shall in no way decrease guarantee period required for acceptable corrected or replaced items of materials or equipment.
- E. Nothing in this Section shall be construed to limit, relieve or release Contractor's, subcontractors' and equipment suppliers' liability to CLPCCD for damages sustained as result of latent defects in equipment caused by negligence of suppliers' agents, employees or subcontractors. Stated in another manner, warranty contained in the Contract Documents shall not amount to, nor shall it be deemed to be, waiver by CLPCCD of any rights or remedies (or time limits in which to enforce such rights or remedies) it may have for defective workmanship or defective materials under laws of this State pertaining to acts of negligence.

1.10 WARRANTIES AND BONDS

- A. Execute Contractor's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers.
 - 1. Provide table of contents and assemble in 8-1/2 inches by 11 inches three-ring binder with durable plastic cover.
 - 2. Assemble in Specification Section order.
 - 3. Provide an electronic copy of all warranties on thumb drive in PDF format
- B. Submit material prior to final application for payment.
 - 1. For equipment put into use with CLPCCD's permission during construction, submit within ten (10) working days after first operation.

2. For items of Work delayed materially beyond Date of Substantial Completion, provide updated submittal within ten (10) working days after acceptance, listing date of acceptance as start of warranty period.
- C. Warranties are intended to protect CLPCCD against failure of work and against deficient, defective and faulty materials and workmanship, regardless of sources.
 - D. Limitations: Warranties are not intended to cover failures, which result from the following:
 - Unusual or abnormal phenomena of the elements
 - Vandalism after substantial completion
 - Insurrection or acts of aggression including war
 - E. Related Damages and Losses: Remove and replace Work which is damaged as result of defective Work, or which must be removed and replaced to provide access for correction of warranted Work.
 - F. Warranty Reinstatement: After correction of warranted Work, reinstate warranty for corrected Work to date of original warranty expiration or to a date not less than 365 days after corrected Work was done, whichever is later.
 - G. Replacement Cost: Replace or restore failing warranted items without regard to anticipated useful service lives.
 - H. Warranty Forms: Submit drafts to Construction Manager for approval prior to execution. Forms shall not detract from or confuse requirements or interpretations of Contract Documents.
 1. Warranty shall be countersigned by manufacturers.
 2. Where specified, warranty shall be countersigned by subcontractors and installers.
 - I. Rejection of Warranties: CLPCCD reserves right to reject unsolicited and coincidental product warranties, which detract from or confuse requirements or interpretations of Contract Documents.
 - J. Term of Warranties: For materials, equipment, systems and workmanship warranty period shall be two (2) years minimum from date of substantial completion of entire Work except where:
 1. Detailed specifications for certain materials, equipment or systems require longer warranty periods.
 2. Materials, equipment or systems are put into beneficial use of CLPCCD prior to Substantial Completion as agreed to in writing by Construction Manager.
 - K. Warranty of Title: No material, supplies, or equipment for Work under Contract shall be purchased subject to any chattel mortgage, security agreement, or under a conditional sale or other agreement by which an interest therein or any part thereof is retained by seller or supplier. Contractor warrants good title to all material, supplies, and equipment installed or incorporated in Work and agrees upon completion of all work to deliver the Site, together with improvements and appurtenances constructed or placed thereon by Contractor, to CLPCCD free from any claim, liens, security interest, or charges, and further agrees that neither Contractor nor any person, firm, or corporation furnishing any materials or labor for any Work covered by Contract shall have right to lien upon the Site or improvement or appurtenances thereon. Nothing contained in this Paragraph, however, shall defeat or impair right of persons furnishing materials or labor under bond given by Contractor for their protection or any rights under law permitting persons to look to funds due Contractor in hands of CLPCCD.

1.11 TURN-IN

Contract will not be closed out and final payment will not be made until all personnel Identification Media, vehicle permits and keys issued to Contractor during prosecution of Work are turned in to CLPCCD.

1.12 RELEASE OF CLAIMS

Contract will not be closed out and final payment will not be made until Contract Agreement and Release of Any and All Claims, is completed and executed by Contractor and CLPCCD.

1.13 FIRE INSPECTION COORDINATION

Contractor shall coordinate fire inspection and secure sufficient notice to CLPCCD to permit convenient scheduling.

PART 2 – PRODUCTS

Not applicable to this section.

PART 3 – EXECUTION

Not applicable to this section.

END OF SECTION

SECTION 01 7329

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Work Included: This Section establishes general requirements pertaining to cutting, fitting, and patching of the work required to:
 1. Make the several parts fit properly.
 2. Uncover work to provide for installation, inspection, or both of ill-timed work.
 3. Remove and replace work not conforming to requirements of the Contract Documents.
 4. Remove and replace defective work.

1.3 QUALITY ASSURANCE

- A. Perform all cutting and patching in accordance with pertinent requirements of the specifications and in the event no such requirements are determined, in conformance with the Architect's written direction. In the absence of either of the previous, the work shall be completed as a minimum to industry standards for the given scope and project.
- B. In all cases, exercise extreme care in cutting operations and perform such operations under adequate supervision by competent mechanics skilled in the applicable trade. Openings shall be neatly cut and shall be kept as small as possible to avoid unnecessary damage. Careless and/or avoidable cutting damage, etc., will not be tolerated, and the Contractor will be held responsible for such avoidable or willful damage.
- C. All replacing, patching, and repairing of materials and surfaces cut or damaged in the execution of the work shall be performed by experienced mechanics of the several trades involved. Such replacing, repairing, and/or patching shall be done with the applicable materials, in such a manner that all surfaces so replaced, etc., will upon completion of the work, match the surrounding similar surfaces.

1.4 SUBMITTALS

- A. Request for the Architect's Consent:
 1. Prior to cutting which affects structural safety, submit a written request to the Architect for permission to proceed with cutting.
 2. Should conditions of the work, or schedule, indicate a required change of materials or methods for cutting and patching, notify the Architect and secure his written permission prior to proceeding.
- B. Notices to the Architect:
 1. Submit written notice to the Architect and Construction Manager designating the time the work will be uncovered, therefore providing a time for the Architect's observation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. For replacement of work removed, use materials which comply with the pertinent Section of these specifications. If materials are not covered within these documents, products and methods shall be provided and installed to match existing conditions.

2.2 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements, which affects:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods, which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
- E. Cut rigid materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Document.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
- J. Identify any hazardous substance or condition exposed during the Work to the Architect for decision or remedy.

PART 3 - EXECUTION

3.1 CONDITIONS

- A. Inspect existing conditions, including elements subject to movement or damage during cutting and patching.
- B. After uncovering the work, inspect conditions affecting installation of new work.

3.2 DISCREPANCIES

- A. If uncovered conditions are not as anticipated, immediately notify the Architect through the Construction Manager and secure needed directions.
- B. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 PREPARATION PRIOR TO CUTTING

- A. Provide all required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the work.

3.4 PERFORMANCE

- A. Perform cutting and demolition by methods which will prevent damage to other portions of the work and will provide a proper surface to receive new installation or repair and new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerance and finishes.

END OF SECTION

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SECTION 017419

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Administrative and procedural requirements for the following:
 1. Salvaging non-hazardous demolition and construction waste.
 2. Recycling non-hazardous demolition and construction waste.
 3. Disposing of non-hazardous demolition and construction waste.

1.3 RELATED SECTIONS

- A. Section 01 5000 - Temporary Facilities: Environmental-protection measures during construction, and location of waste containers at Project site.

1.4 REFERENCES

- A. CALGreen – California Green Building Standards 2019 Edition.
- B. USGBC – LEED NC v4.2 Building Design and Construction for New Construction.

1.5 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.6 PERFORMANCE GOALS

- A. The Owner has established the following sustainable building goals for the project. Although these goals are mostly general in nature, they also include some specific performance targets. Refer to the specific specification sections for more detailed requirements and reference standards. Notify the Owner and the Architect if conflicts arise between the performance of the work and the sustainable building goals. This specification is not intended to limit the alternative means of achieving these goals. Suggestions and input from the contractor(s) for implementing these goals and a team approach are encouraged.
- B. Create spaces that are healthy and comfortable for occupants.
1. Select low toxic building products and materials.
 2. Select non-toxic environmentally safe cleaning products and procedures.
 3. Implement an integrated pest management program.
- C. Use sustainable or renewable materials.
1. Select Forest Stewardship Council (FSC) certified wood products for furnishings and temporary construction applications such as bracing, concrete formwork and pedestrian barriers.
 2. Select rapidly renewable materials that sustainably replenish themselves in a less than 10-year cycle (e.g. linoleum: cork and linseed).
 3. Select materials that minimize damage to natural habitats.
- D. Use resources efficiently.
1. Select materials that use resources efficiently.
 2. Use construction practices that achieve the most efficient use of resources and materials.
 3. Recycle minimum 75% (by weight) of construction, demolition and land-clearing debris, excluding Alternative Daily Cover (ADC). Make sure facility has the option of reporting excluding alternative Daily Cover. A minimum of 4 waste streams must be separated on site. Refer to LEED v4.2 BD+C reference guide Construction waste prerequisite and credit for further detail.
 4. Select recycled content materials (target is 20% of building materials that contain in aggregate a minimum average the post-consumer recycled content and 50% post industrial recycled content).
 5. Select materials that can be recycled at the end of their useful life (e.g. metal products, carpet).
- E. Use durable materials.
1. Select materials with the longest usable life.
 2. Select materials with the least burdensome maintenance requirements.
- F. Utilize life-cycle analysis in material selection.
1. Select materials that generate the least amount of pollution. Consider pollution and toxins generated during harvesting, mining, manufacturing, transport, installation, use and disposal.
 2. Select materials that are manufactured regionally within 500 miles (target is 25% by weight) to support local materials and labor and reduce energy used to transport materials.
 3. Select materials with low-embodied energy (e.g. energy used to transport and produce building materials).
- G. Salvage/Recycle Goals: Owner's goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:
1. Demolition Waste:
 - a. Asphaltic concrete paving.

- b. Concrete.
2. Construction Waste:
 - a. Site-clearing waste.
 - b. Masonry and CMU.
 - c. Lumber.
 - d. Wood sheet materials.
 - e. Wood trim.
 - f. Metals.
 - g. Roofing.
 - h. Insulation.
 - i. Gypsum board.
 - j. Piping.
 - k. Electrical conduit.
 - l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.7 SUBMITTALS

- A. Waste Management Plan: Submit 3 copies of plan within 7 days of date established for commencement of the Work or Notice to Proceed.
- B. Waste Reduction Progress Reports – provide quarterly updated reports on waste diversion rate: Concurrent with each Application for Payment, submit three copies of report. Include separate reports for demolition and construction waste. Include the following information:
 1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons (tonnes).
 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

- H. **Statement of Refrigerant Recovery:** Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.8 QUALITY ASSURANCE

- A. **Regulatory Requirements:** Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. **Waste Management Conference:** Conduct conference at Project site to comply with requirements in Section 013119. Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.9 WASTE MANAGEMENT PLAN

- A. **General:** Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. **Waste Identification:** Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. **Waste Reduction Work Plan:** List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. **Salvaged Materials for Reuse:** For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. **Salvaged Materials for Sale:** For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. **Salvaged Materials for Donation:** For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. **Recycled Materials:** Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. **Disposed Materials:** Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. **Handling and Transportation Procedures:** Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. **Cost/Revenue Analysis:** Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Construction Manager. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Section 01500 for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared between Contractor and Owner equally.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch (38-mm) size or as suitable for reuse as noted below.
 - 1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earthwork and Grading" upon Geotech's acceptance for suitability for use as general fill.
- B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch (38-mm) size or as suitable for reuse as noted below.
 - 2. Crush concrete and screen to comply with requirements in Division 31 Section "Earthwork and Grading" upon Geotech's acceptance for use as satisfactory soil for fill or subbase.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.
 - 1. Verify with Division 32 "Planting" requirements for viable use of chipped organic waste as organic mulch and comply accordingly.

- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Verify with requirements in Division 32 Section "Planting" for viable use of clean sawdust as organic mulch and comply accordingly.
- D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Verify with requirements in Division 32 Section "Planting" for viable use of clean ground gypsum board as inorganic soil amendment and comply accordingly.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

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SECTION 01 7800

PROJECT RECORDS DOCUMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for Project Record Documents.
- B. Project Record Documents required include:
 - 1. Marked-up copies of Drawings
 - 2. Marked-up copies of Shop Drawings
 - 3. Newly prepared Drawings
 - 4. Marked-up copies of Specifications, Addenda, Change Orders and CCDs
 - 5. Marked-up Product Data submittals
 - 6. Record Samples
 - 7. Field records for variable and concealed conditions
 - 8. Record information on Work that is recorded only schematically
 - 9. Maintenance forms for major equipment
- C. Specific Project Record Documents requirements that expand requirements of this Section are included in the individual Sections of Divisions 2 through 33.
- D. General Project closeout requirements are included in Section 01 70 00 (Contract Closeout).
- E. Maintenance of Documents and Samples:
 - 1. Store Project Record Documents and Samples in the field office apart from Contract Documents used for construction.
 - 2. Do not permit Project Record Documents to be used for construction purposes.
 - 3. Maintain Project Record Documents in good order and in a clean, dry, legible condition.
 - 4. Make Documents and Samples available at all times for inspection by District.
- F. District will provide one full size blue-line set of the Drawings and one Project Manual for Contractor's use for recording as-built conditions.

1.2 PROJECT RECORD DRAWINGS

- A. Mark-up Procedure: During the construction period, maintain a set of blue-line or blackline prints of Contract Drawings and Shop Drawings for Project Record Documents purposes. Label each document (on first sheet or format page) "PROJECT RECORD" in 2-inch high printed letters. Keep record documents current. Note: A reference by number to a Change Order, CCD, RFI, RFQ, RFP, Field Order or other such document is not acceptable as sufficient record information on any record document. Do not permanently conceal any Work until required information has been recorded.
 - 1. Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:
 - a. Dimensional changes to the Drawings
 - b. Revisions to details shown on the Drawings
 - c. Depths of various elements of foundation in relation to main floor level or survey datum
 - d. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements

- e. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure
 - f. Locations of underground work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stub outs, invert elevations, and similar items
 - g. Actual numbering of each electrical circuit
 - h. Field changes of dimension and detail
 - i. Revisions to routing of piping and conduits
 - j. Revisions to electrical circuitry
 - k. Actual equipment locations
 - l. Duct size and routing
 - m. Changes made by Change Order or CCD
 - n. Details not on original Contract Drawings
2. Mark completely and accurately Project Record Drawing prints of Contract Drawings or Shop Drawings, whichever is the most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
 3. Mark Project Record Drawing sets with red, erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.
 4. Mark important additional information that was either shown schematically or omitted from original Drawings.
 5. Note CCD numbers; alternate numbers, Change Order numbers, and similar identification.
 6. Responsibility for Mark-up: Where feasible, the individual or entity who obtained Project Record Drawing data, whether the individual or entity is the installer, Subcontractor, or similar entity, is required to prepare the mark-up on Project Record Drawings.
 - a. Accurately record information in an understandable and legible drawing technique.
 - b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
- B. Preparation of Record Drawings: Immediately prior to inspection for Certification of Substantial Completion, review completed marked-up Project Record Drawings with District. When authorized, prepare a full set of correct transparencies of Contract Drawings and Shop Drawings.
1. Incorporate changes and additional information previously marked on print sets. Erase, redraw, and add details and notations where applicable. Identify and date each Drawing; include the printed designation "PROJECT RECORD DRAWING" in a prominent location on each Drawing.
 2. Refer instances of uncertainty to District for resolution.
 3. Distribution: Whether or not changes and additional information were recorded, organize and bind original marked-up set of prints that were maintained during the construction period into manageable sets. Bind the set with durable paper cover sheets, with appropriate identification, including titles, dates, and other information on cover sheets.
- C. Distribution of Marked-Up Drawings: Submit three full, bound sets and one digital set in AutoCAD 2000 format, the marked-up Project Record Drawings set to District for District's records.
- D. Shop Drawings and Samples: Maintain as record documents; legibly annotate Shop Drawings and Samples to record changes made after review.
- E. In addition to requirements of this Section, comply with supplemental requirements of Divisions 15 and 16.
1. Divisions 15 and 16 of the Specifications require the preparation of large scale, detailed layout drawings of the Work of those Divisions. These layout drawings are not Shop Drawings as defined by General Conditions, but together with Shop Drawings or layout

drawings of all other affected Sections are used to check, coordinate, and integrate the work of the various Sections.

2. Include these layout drawings as part of the Project Record Documents.

1.3 PROJECT RECORD SPECIFICATIONS

- A. During the construction period, maintain one copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents purposes.
- B. Mark the Project Record Specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and Modifications issued. Note related Project Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, Change Order and Construction Change Directive work, and information on concealed installation that would be difficult to identify or measure and record later.
 1. In each Specification Section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
 2. Record the name of the manufacturer, catalog number, supplier and installer, and other information necessary to provide a record of selections made and to document coordination with Project Record Product Data submittals and maintenance manuals.
 3. Note related Project Record Product Data, where applicable, for each principal product specified, indicate whether Project Record Product Data has been submitted in maintenance manual instead of submitted as Project Record Product Data.
 4. Upon completion of mark-up, submit Project Record Specifications to District for District's records.

1.4 ADDITIONAL REQUIREMENTS FOR FINAL PROJECT RECORD DOCUMENTS

- A. Prior to Substantial Completion of the Work, District will make available to Contractor originals of the Drawings and Specifications, as Microsoft® Word 2000 for Windows, and AutoCAD 2000 Land Development Desktop for Windows in drawing format (.DWG) files. Note all changes thereon for the final Project Record Documents and provide one set of mylar reproducible, one set of revised Specifications and one set of disks or CDs to be submitted to District.
- B. After Substantial Completion and before Final Completion, carefully transfer all data shown on the job set of Record Drawings to the corresponding computer files, coordinating the information as required.
- C. Clearly indicate at each affected detail and other drawings a full description of changes made during construction, and the actual location of items as previously specified.
- D. "Cloud" all affected areas.
- E. Stamp each Record Drawing with the following information:
 1. Project Record Document.
 2. Prepared by: Contractor's name, permanent address.
 3. Date prepared.
 4. Contractor's signature.
 5. District Contract Number.

1.5 PROJECT RECORD PRODUCT DATA

- A. During the construction period, maintain one copy of each Project Record Product Data submittal for Project Record Document purposes.
 1. Mark Project Record Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Project Record Product Data submitted. Include significant changes in the product delivered to the Site, and changes in manufacturer's instructions and recommendations for installation.
 2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 3. Note related Change Orders and mark-up of Project Record Drawings, where applicable.
 4. Upon completion of mark-up, submit a complete set of Project Record Product Data to District for District's records.
 5. Where Project Record Product Data is required as part of maintenance manuals, submit marked-up Project Record Product Data as an insert in the manual, instead of submittal as Project Record Product Data.
 6. Contractor is responsible for mark-up and submittal of Project Record Product Data for its own Work.
- B. Material, Equipment, and Finish Data:
 1. Provide data for primary materials, equipment and finishes as required under each Specification Section.
 2. Submit three (3) hard copy sets and one (1) digital copy, on compact disc (CD) prior to final inspection, bound in 8-1/2 inches by 11 inches three-ring binders with durable plastic covers; provide typewritten table of contents for each volume.
 3. Arrange by Specification Section number and give names, addresses, and telephone numbers of Subcontractors and suppliers. List:
 - a. Trade names.
 - b. Model or type numbers.
 - c. Assembly diagrams.
 - d. Operating instructions.
 - e. Cleaning instructions.
 - f. Maintenance instructions.
 - g. Recommended spare parts.
 - h. Product data.

1.6 MISCELLANEOUS PROJECT RECORD SUBMITTALS

- A. Refer to other Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the District for District's records. Categories of requirements resulting in miscellaneous records include, but are not limited to, the following:
 1. Field records on excavations and foundations
 2. Field records on underground construction and similar work
 3. Survey showing locations and elevations of underground lines
 4. Invert elevations of drainage piping
 5. Surveys establishing building lines and levels
 6. Authorized measurements utilizing unit prices or allowances
 7. Records of plant treatment
 8. Ambient and substrate condition tests
 9. Certifications received in lieu of labels on bulk products
 10. Batch mixing and bulk delivery records
 11. Testing and qualification of tradespersons
 12. Documented qualification of installation firms

13. Load and performance testing
14. Inspections and certifications by governing authorities
15. Leakage and water-penetration tests
16. Fire resistance and flame spread test results
17. Final inspection and correction procedures
18. Final As-Built Construction Schedule

PART 2 – PRODUCTS

NOT APPLICABLE TO THIS SECTION.

PART 3 – EXECUTION

3.1 RECORDING

Post changes and modifications to the Contract Documents as they occur. Do not wait until the end of the Project. District may periodically review Project Record Documents to assure compliance with this requirement.

3.2 SUBMITTAL

- A. At completion of Project, deliver Project Record Documents to District.
- B. Accompany submittal with transmittal letter containing:
 1. Date
 2. Project title and number
 3. Contractor's name and address
 4. Number and title of each Project Record Document
 5. Certification that each document as submitted is complete and accurate, and signature of Contractor or Contractor's authorized representative.

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SECTION 01 8113

SUSTAINABLE CERTIFICATION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section describes general requirements and procedures to comply with Chabot Las Positas Community College District (CLPCCD), CALGreen, and LEED NC v4.2 criteria for sustainability in construction on CLPCCD projects.
- B. The Design Professional has selected materials and utilized integrated design processes that achieve CLPCCD objectives. Contractor is responsible to maintain and support these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes. By submitting a change or substitution of materials or processes, contractor must demonstrate its diligence in performing the level of investigation and comparison required under Airport and City policies.
- C. A copy of the LEED NC v4.2 Project Checklist is attached at the end of this section.

1.2 DEFINITIONS

- A. **Regional Materials:** Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of project site. If only a fraction of a product or material is extracted or harvested or recovered and manufactured locally, then only that percentage (by weight) must contribute to regional value.
- B. **Environmental Product Declaration (EPD):** A compliant EPD is a third-party declaration with external verification; is product-specific (not industry-wide); conforms to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930; and has at least a cradle-to-gate scope.
- C. **Health Product Declaration (HPD):** A compliant HPD provides full disclosure of known hazards and demonstrates chemical inventory of the product to at least 0.1 percent (1000 ppm).
- D. **California Department of Public Health (CDPH) Standard Method performance and Documentation Requirements:** Building products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario. The manufacturer's or third-party certification must state the exposure scenario used to determine compliance. Claims of compliance for wet-applied products must state the amount applied in mass per surface area. Manufacturers' claims of compliance with the above requirements must also state the range of total VOCs after 14 days (336 hours), measured as specified in the CDPH Standard Method v1.1:
 - 1. 0.5 mg/cubic meter or less;
 - 2. between 0.5 and 5.0 mg/cubic meter; or
 - 3. 5.0 mg/cubic meter or more.
- E. **Volatile Organic Compounds (VOC):** Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.3 REFERENCE STANDARDS & PUBLICATIONS

- A. CALGreen 2019 Code
- B. LEEDv4 Building Design and Construction for New Construction Reference Guide (LEEDv4 BD+C NC)
- C. U.S. Environmental Protection Agency WaterSense Program (WaterSense).
- D. U.S. Environmental Protection Agency ENERGY STAR Program (ENERGY STAR).
- E. Green Electronic Council EPEAT Program (EPEAT).
- F. Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 3, Architectural Coatings, in effect March 1, 1978 and amended on July 1, 2009.
- G. Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 51, Adhesives and Sealants, in effect on July 17, 2002.

1.4 SUBMITTALS

- A. All submittals to be provided by contractor to Architect and Green Building Consultant.
- B. Sustainability Action Plan:
 - 1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
 - 2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
 - 3. Sustainability Action Plan must:
 - a. Make reference to sustainable construction submittals defined by this section.
 - b. Address all items listed under PERFORMANCE CRITERIA.
 - c. Indicate individual(s) responsible for implementing the plan.
- C. Moisture-Protection Plan: Contractor's plan describing procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Describe procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Describe sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and concrete grinding. Describe plans for managing water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- D. Low Pollutant-Emitting Materials Tracking Spreadsheet: Within 30 days after Preconstruction Meeting provide a preliminary Low Pollutant-Emitting Materials Tracking Spreadsheet. The Low Pollutant-Emitting Materials Tracking Spreadsheet must be an electronic file and include all materials on Project in categories described under Low Pollutant-Emitting Materials. Specifically provide the following:
 - 1. General Emissions Testing and Materials Safety Data Sheet showing VOC content in grams per Liter for Paints and Coatings
 - 2. General Emissions Testing for 100% of flooring, including base.
 - 3. Composite Wood Evaluation for 100% of composite wood

4. General Emissions Evaluation for 100% of ceilings, Walls, thermal and acoustic insulation
- E. Construction Waste Management - see Sec. 01 7419.
- F. Construction Indoor Air Quality (IAQ) Management Plan:
1. Not more than 30 days after Preconstruction Meeting provide a Construction IAQ Management Plan as an electronic file including descriptions of the following:
 - a. **New LEEDv4 requirement – smoking is not allowed within the building or within 25'-0" of building site during construction. Make sure this requirement is identified in the IAQ Plan and communicated to all workers.**
 - b. Instruction procedures for meeting or exceeding all applicable recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3 including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling.
 - c. Instruction procedures for protecting absorptive materials stored on-site or installed from moisture damage.
 - d. Schedule of submission of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials.
 - e. Instruction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille.
 - f. Instruction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit.
 - g. Instruction procedures and schedule for implementing building flush-out.
 - h. Instruction procedures and schedule for implementing building air testing in compliance with LEED v4.2 as follows:
 - 1) After construction ends and before occupancy, but under ventilation conditions typical for occupancy, conduct baseline IAQ testing using protocols consistent with the methods listed in Table 1 for all occupied spaces. Use current versions of ASTM standard methods, EPA compendium methods, or ISO methods, as indicated. Laboratories that conduct the tests for chemical analysis of formaldehyde and volatile organic compounds must be accredited under ISO/IEC 17025 for the test methods they use. Retail projects may conduct the testing within 14 days of occupancy.
 - 2) Pollutant thresholds as follows:
 - a) Formaldehyde: 27 ppb ASTM D5197; EPA TO- 11 or EPA Compendium Method IP-6 ISO 16000-3
 - b) Particulates: (PM10 for all buildings; PM2.5 for buildings in EPA nonattainment areas, or local equivalent) PM10: 50 micrograms per cubic meter PM2.5: 15 micrograms per cubic meter EPA Compendium Method IP-10 ISO 7708
 - c) Ozone: (for buildings in EPA nonattainment areas) 0.075 ppm ASTM D5149 - 02 ISO 13964
 - d) Total volatile organic compounds (TVOC s): 500 micrograms per cubic meter EPA TO-1, TO-15, TO-17, or EPA Compendium Method IP-1 ISO 16000-6
 - e) Target chemicals listed in CDPH Standard Method v1.1, Table 4-1, except formaldehyde: CDPH Standard Method v1.1–2010, Allowable Concentrations, Table 4-1 ASTM D5197; EPA TO-1, TO-15, TO-17 ISO 16000-3, 16000-6
 - f) Carbon monoxide (CO): 9 ppm; no more than 2 ppm above outdoor levels EPA Compendium Method IP-3 ISO 4224

- G. Product Submittals:
1. Building Product Transparency for Material Ingredients: The following documentation and certifications are acceptable:
 - a. Building Product Disclosure and Optimization — Environmental Product Declarations
 - 1) Environmental Product Declaration (EPD): Manufacturer's Type III Third Party Verified product life cycle assessment documenting environmental impact of the product throughout its life cycle (i.e., from cradle to gate) that is verified by an ISO/IEC 17065 accredited certification body.
 - 2) Building Product Disclosure and Optimization — Material Ingredients
 - a) Declare Label: Manufacturers publicly available Declare Label and Declare ID#, as included in the Declare database <https://living-future.org/declare-products>
 2. Low Pollutant-Emitting Materials: Submit product data confirming compliance with relevant requirements for all materials on Project in categories described under Low Pollutant-Emitting Materials.
 - a. Provide documentation as required in D above
 3. Building Product Disclosure and Optimization – Environmental Product Disclosure (EPD) Option 1 – Fill out LEED Materials and Resource Calculator and provide EPD documentation for 20 different permanently installed products sourced from at least five different manufacturers
 4. Building Product Disclosure and Optimization – sourcing of Raw Materials Option 2 – provide backup documentation and fill out LEED Materials and Resource Calculator claiming a minimum of 25% of materials costs with material including pre/post consumer recycled content, FSC certified wood and/or local materials.
 5. Building Product Disclosure and Optimization – Health Product Disclosure (HPD) Option 1 - Fill out LEED Materials and Resource Calculator and provide HPD documentation for 20 different permanently installed products sourced from at least five different manufacturers
- H. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, submit a Sustainable Construction Progress Report to confirm adherence with Sustainability Action Plan.
1. Include narratives of revised strategies for bringing work progress into compliance with plan and product submittal data and calculations to demonstrate compliance with thresholds based on materials costs.
 2. Include updated and current Project Materials Cost Data Spreadsheet.
 3. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
 4. Include construction waste tracking, in tons or cubic yards, including waste description, whether diverted or landfilled, hauler, and percent diverted for comingled quantities; and excluding land-clearing debris and soil. Provide haul receipts and documentation of diverted percentages for comingled wastes.
- I. Closeout Submittals: Within 14 days after Substantial Completion provide the following:
1. Final version of Low Pollutant-Emitting Materials Tracking Spreadsheet.
 2. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed air handling units are used during construction.
 3. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for final filtration media in air handling units.
 4. Minimum 18 construction photographs including six photographs taken on three different occasions during construction of ANSI/SMACNA 008-2008, Chapter 3 approaches employed, along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 5. Flush-out Documentation:

- a. Product data for filtration media used during flush-out.
- b. Product data for filtration media installed immediately prior to occupancy.
- c. Signed statement describing building air flush-out procedures including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

1.5 SUBSTITUTIONS

- A. Substitution requests for product types specified or indicated in the Contract Documents are also governed by this Section and shall meet the minimum requirements specified herein. Substitution requests shall require documentation indicating compliance with the relevant requirements specified in this Section.
 1. For products where compliance with specified IAQ, Materials Transparency requirements may not be possible, alternative IAQ solutions shall be developed by the Contractor and approved by Architect before being implemented.

1.6 QUALITY ASSURANCE

- A. Preconstruction Meeting: After award of Contract and prior to commencement of Work, schedule and conduct meeting with Sustainability Lead and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the Sustainable Construction Requirements and coordination of contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Construction Waste Management
 1. Construction waste diversion from landfill disposal must comprise at least 75 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal. Diverted materials must include at least four material streams.
- B. Field-Applied Interior Paints & Coatings
 1. All products shall be CDPH Standard Method v1.1 compliant, and shall meet the applicable VOC limits of the Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 3 as follows AND provide General Emissions Evaluation documentation.
 2. BAAQMD Regulation 8, Rule 3 Table 2 Excerpt: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits:
 - a. Flat Coatings: 50 g/L.
 - b. Non-flat Coatings: 100 g/L.
 - c. Non-flat – High Gloss Coatings: 150 g/L.
 - d. Primers, Sealers, and Undercoaters: 100 g/L.
 - e. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - f. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

- g. Pretreatment Wash Primers: 420 g/L.
 - h. Wood Coatings: 275 g/L.
 - i. Wood Preservatives: 350 g/L.
 - j. Clear Wood Finishes, Lacquers: 550 g/L.
 - k. Floor Coatings: 100 g/L.
 - l. Shellacs, Clear: 730 g/L.
 - m. Shellacs, Pigmented: 550 g/L.
 - n. Stains: 250 g/L.
- C. Field-Applied Interior Adhesives, Mastics, Glues, & Sealants
- 1. All products shall meet the applicable chemical content requirements of BAAQMD Regulation 8, Rule 51, Adhesive Products, Application, Adhesive Product Substrate, and Sealant Product limits, excerpted as follows:
 - a. Indoor Floor Covering Installation: 150 g/L.
 - b. Multipurpose Construction: 200 g/L.
 - c. Nonmembrane Roof Installation/Repair: 300 g/L.
 - d. Structural Glazing: 100 g/L.
 - e. Ceramic Tile Installation: 130 g/L.
 - f. Cove Base Installation: 150 g/L.
 - g. Perimeter Bonded Sheet Vinyl Flooring Installation: 660 g/L.
 - h. Contact Bond Adhesive: 250 g/L.
 - i. Adhesive Primer for Plastic: 650 g/L.
 - j. Metal Substrates: 30g/L.
 - k. Porous Material Substrates: 120 g/L.
 - l. Architectural Sealants: 250 g/L.
 - m. Sealant Primers for Nonporous Substrates: 250 g/L.
 - n. Sealant Primers for Porous Substrates: 775 g/L.
 - o. Other Sealant Primers: 750 g/L.
- D. Each flooring element installed in the building interior which is not inherently non-emitting must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.
- E. Ceiling, wall, thermal and acoustic insulation products which are not inherently non-emitting must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.
- F. Energy Star Equipment
- 1. Equipment being installed which fall into a category covered by the following select Energy Star program product categories must be Energy Star-labeled.
 - a. Air Purifiers and Cleaners.
 - b. Audio/Video Equipment.
 - c. Computers: Desktops, Workstations, and Thin Clients.
 - d. Computers: Notebooks and Integrated Computers.
 - e. Small-Scale Servers.
 - f. Data Center Storage.
 - g. Displays.
 - h. Uninterruptible Power Supplies.
 - i. Refrigerators and Freezers.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Construction Indoor Air Quality Management additional requirement:

1. Perform air quality testing.
 - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the LEED Reference Guide for Building Design and Construction, latest Edition.
 - b. Demonstrate that contaminant maximum concentrations listed below are not exceeded:
 - 1) Formaldehyde: 27 ppb.
 - 2) Particulates (PM10): 50 micrograms/cu. m.
 - 3) Ozone (for buildings in EPA nonattainment areas): 0.075 ppm.
 - 4) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
 - 5) Target chemicals listed in CDPH Standard Method v1.1, Table 4-1, except formaldehyde: CDPH Standard Method v1.1-2010, Allowable Concentrations, Table 4-1.
 - 6) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - c. For each sampling point where maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from same locations as in the first test.
 - d. Air-sample testing must be conducted as follows:
 - 1) Measurements must be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at minimum outside air flow rate for occupied mode throughout duration of air testing.
 - 2) Building must have all interior finishes installed including millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for testing.
 - 3) Number of sampling locations varies depending on size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, number of sampling points must not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and must include areas with the least ventilation and greatest presumed source strength.
 - 4) Air samples must be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

3.2 ATTACHMENTS

- A. LEED NC v4.2 Project Checklist

END OF SECTION



LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name: LPC - Horticulture Facility

Date: 7/8/20

Y ? N

1	0	0	Credit	Integrative Process	1
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5	1	10	Location and Transportation		16
0	0	0	Credit	LEED for Neighborhood Development Location	16
1	0	0	Credit	Sensitive Land Protection	1
1	0	1	Credit	High Priority Site	2
2	0	3	Credit	Surrounding Density and Diverse Uses	5
0	0	5	Credit	Access to Quality Transit	5
1	0	0	Credit	Bicycle Facilities	1
0	0	1	Credit	Reduced Parking Footprint	1
0	1	0	Credit	Green Vehicles	1

5	0	5	Sustainable Sites		10
Y			Prereq	Construction Activity Pollution Prevention	Required
1	0	0	Credit	Site Assessment	1
0	0	2	Credit	Site Development - Protect or Restore Habitat	2
1	0	0	Credit	Open Space	1
0	0	3	Credit	Rainwater Management	3
2	0	0	Credit	Heat Island Reduction	2
1	0	0	Credit	Light Pollution Reduction	1

6	0	5	Water Efficiency		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
2	0	0	Credit	Outdoor Water Use Reduction	2
2	0	4	Credit	Indoor Water Use Reduction	6
1	0	1	Credit	Cooling Tower Water Use	2
1	0	0	Credit	Water Metering	1

17	10	6	Energy and Atmosphere		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
3	0	3	Credit	Enhanced Commissioning	6
9	9	0	Credit	Optimize Energy Performance	18
0	1	0	Credit	Advanced Energy Metering	1
0	0	2	Credit	Demand Response	2
3	0	0	Credit	Renewable Energy Production	3
0	0	1	Credit	Enhanced Refrigerant Management	1
2	0	0	Credit	Green Power and Carbon Offsets	2

4	3	6	Materials and Resources		13
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
0	0	5	Credit	Building Life-Cycle Impact Reduction	5
1	0	1	Credit	Building Product Disclosure and Optimization - EPD	2
1	1	0	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	1	0	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1	1	0	Credit	Construction and Demolition Waste Management	2

10	5	1	Indoor Environmental Quality		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2	0	0	Credit	Enhanced Indoor Air Quality Strategies	2
1	2	0	Credit	Low-Emitting Materials	3
1	0	0	Credit	Construction Indoor Air Quality Management Plan	1
1	0	1	Credit	Indoor Air Quality Assessment	2
1	0	0	Credit	Thermal Comfort	1
2	0	0	Credit	Interior Lighting	2
1	2	0	Credit	Daylight	3
1	0	0	Credit	Quality Views	1
0	1	0	Credit	Acoustic Performance	1

4	2	0	Innovation		6
1	0	0	Credit	Green Building Education	5
1	0	0	Credit	Green Cleaning/IPM	
1	0	0	Credit	EP Renewable Energy	
0	1	0	Credit	Mechanical Ionization	
0	1	0	Credit	Innovation: Ergo or SPP	
1	0	0	Credit	LEED Accredited Professional	1

2	0	2	Regional Priority		4
0	0	1	Credit	RP: Access to quality transit (5)	1
1	0	0	Credit	RP: Optimize Energy Performance (10)	1
0	0	1	Credit	RP: Indoor Water Use Reduction (4)	1
1	0	0	Credit	RP: BPDO-Raw Materials	1

54	21	35	TOTALS	Possible Points:	110
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Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

SECTION 01 9113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the Owner's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:
1. Verify that the applicable equipment and systems are installed in accordance with the contact documents and according to the manufacturer's recommendations.
 2. Verify and document proper integrated performance of equipment and systems.
 3. Verify that Operations & Maintenance documentation is complete.
 4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
 5. Verify that the Owner's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
 6. Document the successful achievement of the commissioning objectives listed above.
- B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the technical sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.
- C. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, apply to this Section.
- B. Related Sections include the following:
1. Division 22: Plumbing
 2. Division 23: Heating Ventilating and Air Conditioning
 3. Division 26: Electrical
 4. Division 32: Exterior Improvements

1.3 DEFINITIONS

- A. Basis of Design (BoD) document: A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning: - A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner's Project Requirements.
- C. Control System: A component of environmental, HVAC, security and fire systems for reporting, monitoring and issuing of commands.
- D. Deficiency or Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components.
- E. CxA: Commissioning Authority. The entity identified by the Owner who leads, plans, and schedules and coordinates the commissioning team to implement the commissioning process.
- F. Functional Testing: Generally, refers to testing of a complete system and demonstrates control of equipment and the interaction of equipment or systems. Performed by the contractor and witnessed by the CxA.
- G. Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.
- H. Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated system's performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, and other similar tests as determined for each specific project.
- I. Issues Log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the commissioning team during the course of the commissioning process. Maintained by the CxA.
- J. Owner's Project Requirements (OPR): A collection of documents that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- K. Owner: Project Owner or designated representative.

- L. Issues Log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the commissioning team during the course of the commissioning process. Maintained by the CxA.
- M. Pre-functional Checklists (PFC): Refers to checklists prepared by the CxA and provided to the contractor to document the complete installation of equipment or systems. Pre-functional checklists are completed by the contractors prior to start-up.
- N. Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT's include installation verification and system and component start up tests.
- O. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- P. Seasonal Performance Tests: Functional Tests that are deferred until the system(s) will experience conditions closer to their design conditions.
- Q. Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.
- R. Start-up: The initial starting or activating of dynamic equipment or the initial energization and programming of control systems.
- S. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- T. TAB: A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.
- U. Training Plan: A written document that details the expectations, schedule and deliverables of commissioning process activities related to training of project operating and maintenance personnel, users and occupants.
- V. Trending: The monitoring by a building management system or other electronic data gathering equipment and analyzing of the data gathered over a period of time to verify proper equipment or systems sequence of operations.
- W. Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.
- X. Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

1.4 COMMISSIONING TEAM

- A. A project team created to coordinate the commissioning effort that coordinates and communicates with the rest of the project team, attend meetings, and solve problems. This team includes representatives from the contractor, subcontractors and owner.
- B. The prime contractor shall in addition to their representative also appoint a representative from each subcontractor involved in commissioned systems including mechanical, electrical, controls, Test and Balance, and plumbing systems.
- C. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Construction Project Manager (CM). Thus, the procedures outlined in this specification must be executed within the following limitations:
 - 1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Owner and the Contractor.
 - 2. Commissioning Issues identified by the Commissioning Agent will be delivered to the Construction Manager and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
 - 3. In the event that any Commissioning Issues and suggested resolutions are deemed by the Construction Manager to require either an official interpretation of the construction documents or require a modification of the contract documents, the Construction Manager will issue an official directive to this effect.
 - 4. All parties to the Commissioning Process shall be individually responsible for alerting the Construction Manager of any issues that they deem to constitute a potential contract change prior to acting on these issues.
 - 5. Authority for resolution or modification of design and construction issues rests solely with the Construction Manager, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.5 OWNER'S RESPONSIBILITIES

- A. Participate in resolution of issues that may occur as a result of the commissioning process.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
 - 1. Coordination meetings.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Testing meetings.
 - 4. Demonstration of operation of systems, subsystems, and equipment.

1.6 CONTRACTOR'S AND SUBCONTRACTOR'S RESPONSIBILITIES

- A. Provide utility services required for the commissioning process.

- B. Contractor is responsible for construction means, methods, job safety, or management function related to commissioning on the job site.
- C. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
 - 1. Participate in construction-phase commissioning meetings including controls coordination meeting to review and resolve any issues with the sequence of operations.
 - 2. Participate in maintenance orientation and inspection.
 - 3. Participate in operation and maintenance training sessions.
 - 4. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 - 5. Perform quality control of all work and certify it is complete prior to request for inspection.
 - 6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
- D. Contractor shall integrate all commissioning activities into Contractor's master construction schedule.
- E. Contractor shall provide a means to effectively commission the BMS system including the following at minimum; schedule the controls contractor that was an integral part of programming the building BMS to run the tests, provide a table with chairs, and provide a 17" 1080p monitor with cables for connection to the controls contractor's laptop.
- F. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
 - 1. Participate in construction-phase coordination meetings.
 - 2. Participate in maintenance orientation and inspection.
 - 3. Complete pre-functional checklists for all equipment. Submit completed forms with start-up reports immediately after start up.
 - 4. Schedule and perform duct air leakage testing as specified in the technical specification sections with CxA as witness.
 - 5. Provide flushing plans, disinfection reports and water treatment reports to the CxA for review.
 - 6. Participate in pre-TAB meeting and jobsite inspections to verify TAB readiness.
 - 7. Provide draft completed TAB report to CxA for review. CxA will identify up to 20% of TAB report for TAB contractor to demonstrate compliance to the completed TAB report.
 - 8. Participate in procedures meeting for testing.
 - 9. Perform point-to-point, calibration and checkout of the building automation system and provide completed report to the CxA for review.
 - 10. Participate in final review at acceptance meeting.
 - 11. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
 - 12. Provide information to the CxA for developing construction-phase commissioning plan.
 - 13. Participate in training sessions for operation and maintenance personnel.

14. Verify that all systems function correctly by testing each mode of operation, alarm and system function.
15. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified.
16. Perform quality control of all work and certify it is complete prior to request for observation and or testing.
17. Complete and sign Systems Functional Testing Readiness Certification and Notification Letter for Commissioning and provide to CxA (See EXHIBIT B of this specification section).
18. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.
19. Perform seasonal testing, at the direction of the CxA, to prove functional performance of the HVAC and controls in the opposite season.

1.7 ARCHITECT AND DESIGN ENGINEER RESPONSIBILITIES

- A. Responsible for developing the construction contract documents and clarifying the design intent during the construction phase of the project.
- B. Performs construction observation.
- C. Contracted directly to OWNER.

1.8 CXA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Prepare a Commissioning Plan. Collaborate with design team, owner, contractor and subcontractors to develop test and inspection procedures. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.
- C. Work with the Contractor to schedule commissioning activities. The Contractor shall integrate all commissioning activities into the master construction schedule. All parties will address scheduling issues in a timely manner in order to expedite the commissioning process.
- D. Review and comment on submittals for compliance with the approved project documents and identify any potential conflicts.
- E. Conduct commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five (5) workdays of the commissioning meeting.
- F. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for permanent power; operation and maintenance data submittals; operation and maintenance training sessions; TAB Work; and Project completion.

- G. Periodically observe and inspect construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.
- H. Prepare Project-specific pre-functional checklists, functional test procedures checklists.
- I. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
- J. Review and comment on operation and maintenance documentation for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."
- K. Review Contractor's operation and maintenance training program. Operation and maintenance training is specified in Division 01 Section "Demonstration and Training."
- L. Prepare commissioning status reports.
- M. Assemble the final commissioning documentation, including the Commissioning Report including applicable Project Record Documents.

1.9 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by CxA, that outlines the process, schedule, allocation of resources, and documentation requirements of the commissioning effort, and shall include, but is not limited to the following:
 - 1. Description of the organization, layout, and content of commissioning documentation to be provided along with identification of responsible parties.
 - 2. Identification of systems and equipment to be commissioned.
 - 3. Description of the level of commissioning for each system
 - 4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
 - 5. Identification of items that must be completed before the next operation can proceed.
 - 6. Description of responsibilities of commissioning team members.
 - 7. Description of observations to be made.
 - 8. Description of requirements for operation and maintenance training, including required training materials.
 - 9. Provide a schedule for commissioning activities with specific dates coordinated with overall construction schedule.
 - 10. Define the process for completing pre-functional and startup checklists for systems, subsystems, and list of specific equipment requiring these checklists.
 - 11. Include Step-by-step procedures for Functional testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
- B. Pre-Functional Checklists: CxA shall develop pre-functional checklists for all equipment to be commissioned. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent may spot check Pre-Functional Checklists

to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

- C. Site Visit Reports: CxA shall record test data, observations, and measurements on site visit forms. Updated Issues Log, photographs and other means appropriate for the application shall be included with Report.
- D. Start-Up Reports: Contractor/Manufacturer created forms that document that factory start-up procedures have been followed for all equipment and systems to be commissioned. Provided by sub-contractors.
- E. Functional Performance Testing: CxA shall develop functional performance test procedures for all equipment and systems to be commissioned. Site Visit Reports: CxA shall record test data, observations, and measurements on site visit forms. Photographs and other means appropriate for the application shall be included with data.
- F. Test and Inspection Reports: CxA shall compile test and inspection reports and test and inspection certificates and include them in Systems Manual and commissioning report.
- G. Commissioning Schedule: CxA shall review and provide input to the master project and construction schedules for commissioning activities.
- H. Issues Log: CxA shall prepare and maintain an issues log that describes installation, and performance issues that are at variance with the Contract Documents. CxA will identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.
 - 1. Creating an Issues Log Entry:
 - a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
 - b. Assign a descriptive title of the issue.
 - c. Identify issue date.
 - d. Identify test number of tests being performed at the time of the observation, if applicable, for cross-reference.
 - e. Identify system, subsystem, and equipment to which the issue applies.
 - f. Identify location of system, subsystem, and equipment.
 - g. Include information that may be helpful in diagnosing or evaluating the issue.
 - h. Note recommended corrective action.
 - i. Identify commissioning team member responsible for corrective action.
 - j. Identify expected date of correction.
 - k. Identify person documenting the issue.
 - 2. Documenting Issue Resolution:
 - a. Log date correction is completed or the issue is resolved.
 - b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
 - c. Identify changes to the Contract Documents that may require action, if any.
 - d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
 - e. Identify person(s) who corrected or resolved the issue.
 - f. Identify person(s) documenting the issue resolution.

- I. Commissioning Report: CxA shall document results of the commissioning process including performance of systems, subsystems, equipment and issues. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD and Contract Documents. The commissioning report shall include, but is not limited to, the following:
 1. Discussion of performance of commissioned systems including any variance from OPR, BoD and the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during OWNER occupancy and operation. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
 2. Commissioning Plan.
 3. Testing plans and reports.
 4. Issues log.
 5. Completed test checklists.
 6. Listing of off-season test(s) not performed and a schedule for their completion.
- J. Systems Manual: CxA shall gather required information and compile Systems Manual. Systems manual shall include, but is not limited to, the following:
 1. As-built system narratives, schematics, and list of installed equipment
 2. Operation and maintenance data

1.10 CXA SUBMITTALS

- A. Commissioning Plan: CxA shall submit a draft commissioning plan. Deliver one copy to Contractor and one to OWNER. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final commissioning plan.
- B. Prefunctional Checklists: CxA shall submit sample checklists and forms to Contractor and subcontractors for review, comment and approval. Contractor completed pre-functional checklists are required to be submitted for review and approved prior to proceeding with functional performance testing.
- C. Functional Test Plan: CxA shall submit draft Functional Test Plan and checklists for comment. The final Functional Test Plan will be submitted and used for functional testing.
- D. Site visit reports: CxA shall submit site visit reports as they are created.
- E. Final Commissioning Report: CxA shall submit the draft commissioning report. One copy, with review comments, will be returned to the CxA for preparation of final submittal. The final report submittal must address previous review comments.
- F. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires facilitating the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum the request will include the manufacturer and model number, the manufacturer printed installation and detailed start-up procedures, sequences of operation, O&M data, performance data, any performance test procedures,

control drawings and details. In addition, the factory checkout sheets or field technicians shall be submitted for review

1.11 COORDINATION

- A. Scheduling: The Contractor shall work with the Commissioning Agent to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction schedule as directed by the Owner.
- B. Coordinating Meetings: CxA shall conduct coordination meetings of the commissioning team as needed to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.
- C. Pretesting Meetings: CxA shall conduct pretest meetings with the commissioning team to review startup reports, coordinate controls sequence of operations, review pretest inspection results, review testing and balancing procedures, review testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.
- D. Testing Coordination: CxA shall coordinate with the OWNER and Contractor to plan the sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS AND FACTORY START UP REPORTS

- A. The following procedures apply to all equipment to be commissioned.
- B. Pre-functional Checklists are developed by the CxA and completed by the appropriate installing contractors for all major equipment and systems being commissioned before functional testing can begin. The checklist captures equipment nameplate and characteristics data, confirming the as-built status of the equipment or system. These checklists also ensure that the systems are complete and operational, so that the functional performance testing can be scheduled. The Contractor and vendors shall execute factory startup and provide the CxA with a copy of the signed and dated completed start-up checklists which will be submitted with the Pre-Functional checklists.
- C. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is

written documentation that each of the manufacturer recommended procedures have been followed and completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

1. The full startup plan shall at a minimum consist of the following items:
 - a. The Pre-Functional Checklists.
 - b. The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.

- D. The Commissioning Agent will review/approve the full start-up plan.

- E. Execution of Pre-functional Checklists and Startup.
 1. Pre-functional checklists will be provided to the project site by the CxA.
 2. The contractor shall maintain a master copy of signed checklists.
 3. The installing contractors shall update the checklists as work is completed. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off.
 4. The CxA will periodically review the checklists for completeness and report on progress at the Cx meetings.

- F. BAS Startup Testing, Adjusting, and Calibration
 1. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
 - a. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance.
 - b. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 - c. Verify integrity/safety of all electrical connections.
 - d. Coordinate with TAB subcontractor to fine tune control settings that are determined from balancing and testing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the BAS, Pre-functional checklists and initiate an associated Action Item:
 - 1) Optimum duct static pressure setpoints for VAV air handling units.
 - 2) Minimum outside air damper settings for air handling units.
 - 3) Optimum differential pressure setpoints for variable speed pumping systems.
 - 4) Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 - 5) BAS contractor shall provide access to the front-end Building Automation System as a minimum to the TAB and CxA to facilitate calibration. Connection for any given device shall local to it (i.e.: at the VAV box or at the thermostat). Shall be made at front end and shall allow querying and editing of parameters required for proper calibration and start up.
 - e. Test, calibrate, and set all digital and analog sensing, and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an

instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Pre-functional Report.

- f. Check each digital control point by making a comparison between the control command at the controller and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the OI display. Record the results for each device in the BAS Pre-functional checklists.
 - g. Verify proper sequences by using the approved checklists to record results and submit with BAS Pre-functional checklists. Verify proper sequence and operation of all specified functions. There is inherent duplication between the functional performance testing of the Testing Contractor, and the thorough checking testing of the sequences by the BAS. Generally, the sequence checkouts indicated as the responsibility of the Testing Contractor under functional testing, must first be tested by the BAS under pre-functional testing.
 - h. Verify proper systems operation under emergency power. Cooperate and coordinate with Testing Contractor and CxA for comprehensive building power outage tests.
 - i. Verify all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
 - j. Verify that all alarm thresholds for all analog devices are entered. Request direction from Owner as to alarm threshold parameters.
 - k. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Prefunctional Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 2 minutes of any upset (for which the system has the capability to respond to) in the control loop, tolerances shall be maintained (exceptions noted):
 - 1) Duct air temperature: $\pm 1^{\circ}\text{F}$.
 - 2) Space Temperature: $\pm 2^{\circ}\text{F}$
 - 3) Hot water temperature: $\pm 2^{\circ}\text{F}$.
 - 4) Duct pressure: $\pm 0.25''$ w.g.
 - 5) Water pressure: ± 1 psid
 - 6) Air flow control: $\pm 5\%$ of setpoint velocity. For min OA flow loops being reset from CO₂, response to upset max time is one hour
 - 7) Space Pressurization (on active control systems): $\pm 0.02''$ wg with no door or window movements
- G. For interface and DDC control panels:
1. Ensure devices are properly installed with adequate clearance for maintenance and clearly labeled in accordance with the record drawings
 2. Ensure terminations are safe, secure and labeled in accordance with the record drawings
 3. Check power supplies for proper voltage ranges and loading.
 4. Ensure wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
 5. Check for adequate signal strength on communication networks.

6. Check for stand-alone performance of controllers by disconnecting the controller from the LAN. Verify the event is enunciated at OIs. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 7. Ensure that controller memory and control network through-put are adequate to support the extensive trending requirements. Reconfigure the system to provide a reliable and robust system as necessary.
 8. Ensure all outputs and devices fail to their proper positions/states.
 9. Ensure buffered and/ or volatile information is held through power outage.
 10. With all system and communications operating normally, sample and record update/enunciation times for critical alarms fed from the panel to the OI.
 11. Check for adequate grounding of all DDC panels and devices.
- H. For Operator Interfaces:
1. Verify all elements on the graphics are functional and properly bound to physical devices and/or virtual points and that hot links or page jumps are functional and logical.
 2. Output all specified system reports for review and approval.
 3. Verify the alarm printing and logging is functional and per requirements
 4. Verify trend archiving to disk and provide a sample to the CxA for review.
 5. Verify paging/dial out alarm enunciation is functional.
 6. Verify functionality of remote OI's and that a robust connection can be established consistently.
 7. Verify that required third party software applications required with the bid are installed and functional.
 8. Verify proper interface with fire alarm system.
- I. Submit Start-Up Test Report. Report shall be completed, submitted and approved prior to functional testing.
- J. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
1. The Contractor shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
 2. The CxA reviews the report and reports to the OWNER. The CxA shall work with the Contractor and vendors to correct and retest deficiencies or uncompleted items.

3.2 FUNCTIONAL PERFORMANCE TESTING

- A. Common Elements for All Systems
1. Have the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements (very cursory review). CxA shall review the content of the documentation and validate that it is per contract documents.
 2. CxA shall review the startup documentation at the start of functional performance testing. Review the startup tests and checklist documentation. CxA shall validate that startup is acceptably executed and complete. CxA shall ensure that any items indicated as outstanding in the checklists is entered as an Action Item and enter one if it is not. The checklists and start up tests/measurements shall be spot checked at the beginning of FPT to ensure accuracy. CxA shall complete a test that indicates he has reviewed the pre-functional checklists and finds them acceptable and note any outstanding items.

3. CxA shall check for and as applicable direct Contractor to demonstrate that access is sufficient to perform required maintenance.
 4. CxA shall validate that all prerequisite work is complete and confirm via a test record that he feels it is.
 5. Specifically check labeling and ensure conformance to contract requirements.
 6. Check proof indication, alarming on failure and restart/acknowledgement as applicable.
 7. CxA shall observe operating conditions encountered at the start of FPT. CxA shall examine for normal functionality and record parameters as a test.
 8. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources.
 9. CxA shall inspect the installation and compare it to contract requirements. Record the inspection as a test.
 10. Capacities and adjusted and balanced conditions as applicable will generally be checked.
 11. Verify all sequence modes and sequences of operation. CxA must initiate all modes and may not refer to or rely on a pre-functional test done by the BAS. Some examples of generic modes that apply to most systems include:
 - a. Off Mode
 - b. Failed Mode: Proof, safeties, power outage etc. See below for crash testing.
 - c. Start Sequence in various modes
 - d. Stop sequences in various modes
 12. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation. CxA is responsible for placing systems in optimal condition for occupancy and not simply relying on initial design estimated settings.
 13. Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints are required to be adjustable, verify that they can be adjusted directly from the graphic screen.
 14. All interfaces between two systems or equipment of different manufacturers must be checked for accuracy and functionality.
 15. "Crash Testing": CxA shall analyze systems to identify possible conditions where functionality may be compromised. CxA shall design non-destructive tests that will demonstrate either the automated response to the conditions or so that team can identify the best method for responding or fixing the condition. All tests and finding shall be documented.
- B. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the Contract Documents. Each system will be tested to verify that the system response is as designed. HVAC systems will be checked for conformance to the design sequences of operation and stable control; lighting control will be checked in each type of lighting area for foot-candles, daylight controls and lighting sensors; plumbing systems will be checked for performance and irrigation control will be checked for zone coverage and programming. Proper system responses to such conditions as power failure, out of limit condition, equipment failure, etc. shall also be tested.

- C. Early duct air leakage tests shall be performed to ensure green and building code compliance. Point-to-point testing will be performed by controls contractor on all applicable systems, with results given to CxA prior to functional performance testing.
- D. Development of Test Procedures: The test procedures are written by the CxA based upon the final operational sequences from available project documentation. The CxA shall develop specific test procedures and forms to verify and document proper operation of each system. Prior to execution, the CxA shall provide a copy of the test procedures to the Contractor who shall review the tests for feasibility, safety, equipment and warranty protection. The test procedure checklists developed by the CxA shall include the following information:
1. System and equipment or component name(s).
 2. Equipment location and ID number.
 3. Date.
 4. Project name.
 5. Participating parties.
 6. Reference to the specification section describing the test requirements, if applicable.
 7. A copy of the specific sequence of operations.
 8. Prerequisites for the test.
 9. Special cautions, alarm limits, etc.
 10. Specific step-by-step procedures to execute the test.
 11. Acceptance criteria of proper performance with a Yes / No/NA check box.
 12. A section for comments.
- E. Test Methods.
1. Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
 - a. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
 - b. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 - c. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 - d. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout

- initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
- e. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout
 - 2. Functional testing is performed by the contractors with the method and degree of testing as defined in this specification for each system. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Contractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems to their pre-test condition.
 - 3. Multiple identical pieces of equipment may be functionally tested using a sampling strategy. The sampling strategy will be defined in these specifications with the commissioned systems list.
- F. Coordination and Scheduling: The Contractor shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the Owners Representative and Contractor upon receipt of the Inspection Request Form. Problem Solving: The CxA will recommend solutions to problems found; however, the burden of responsibility to solve, correct and retest problems is with the Contractor and Owner's consultants.
- G. The CM and contractor must complete the Systems Functional Testing Readiness Certification and Notification Letter for Commissioning included with this section of specifications, see Exhibit B. This form letter is intended to be used as applicable (over and over) to indicate which system or systems are ready for functional testing along with the date the system(s) is ready. Do not wait to have all applicable systems ready before sending the notification letter to the CxA. The notification letter will allow the CxA to produce a schedule for functional testing and coordinate testing with the CM and contractor.

3.3 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Before the operation and maintenance training, CxA shall review training preparation for compliance with project documents.
- B. Training is required per contract specifications. At a minimum, training is required for Mechanical systems, Lighting, and Controls systems.
- C. The CxA requires submission of training records including attendance lists to verify appropriate people received the training.

3.4 COSTS OF COMMISSIONING WORK

- A. The cost to the Contractor and Subcontractors to comply with the specified requirements and to support the work of the CxA shall be included in the Contractor's and Subcontractor's bid price.
- B. If CxA arrives onsite, on the scheduled date for functional testing (as indicated on the Systems Functional Testing Readiness Certification and Notification Letter for Commissioning, see Exhibit B of this specification section) which cannot be completed due to systems readiness failure, systems technician no-show, or other circumstances not caused by CxA resulting in failed functional testing; it is understood that the CxA's client (listed on Exhibit B) will be invoiced for expenses incurred by CxA. The contractor also agrees to reimburse said client for incurred expenses. CxA expenses will be invoiced as follows:
 1. Travel expenses as applicable
 2. \$2,500/day for each on site 3QC CxA
- C. It is the Contractor's responsibility to QC and pre-test all building equipment and systems. The CxA shall confirm function of each system. If a device, piece of equipment, sequence, or system fails a test, corrections shall be made immediately and retested. Corrections that cannot be corrected immediately or that delay completion of CxA testing shall be reimbursed by the Contractor.

3.5 COMMISSIONED SYSTEMS

System	Equipment	Level Note
HVAC	Split System	5
	Supply Fan	5
	Exhaust Fans	5
	Split Heat Pumps	5
	Condensing Units	5
	Test and balance report values	3
Building Management System	Sequences of operation, monitored points, and alarms	5
	Metering/monitoring devices and equipment	5
	Software commissioning, GUI presentation commissioning, system access performance criteria, software tools/source code commissioning, instrument data sheets, middleware commissioning, Internet Protocol commissioning	5
Electrical System	Sweep or scheduled lighting controls	3
	Day-light dimming controls	3
	Lighting occupancy sensors	3
Plumbing System	Domestic Water Heaters	5
	HW Circulation Pump	5
Irrigation	Control System Demonstration	3

Levels Defined:

Level 1 - The CxA will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) to verify operational requirements meet the contract documents.

Level 2 - The CxA will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports). The CxA may spot check some of the system functions verify operational requirements are met.

Level 3 - The CxA will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 20% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CxA. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

Level 4 - The CxA will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 50% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CxA. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

Level 5 - The CxA will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 100% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CxA. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

3.6 METHODS OF TESTING

A. HVAC Systems

1. CxA may witness duct air leakage testing during rough-in. Contractor to forward all duct air leakage reports to CxA for review.
2. CxA will visit the site during rough-in of ductwork, piping and equipment to verify proper maintenance clearances and access are being maintained.
3. The CxA may witness contractor and/or factory start-up of equipment.
4. The TAB contractor shall re-measure up to 20% of the TAB report values for the CxA to observe.
5. Stand-alone controls will be tested independent of item B below.
6. Contractor will demonstrate to the CxA that the operation of each system through all modes, alarms, and operating parameters meet the contract documents.

B. Building Management System

1. After receipt of the controls contractor's calibration and point to point reports by the CxA, the controls contractor will re-measure some of the points for the CxA to verify that the calibration and communication is correct. The points to be verified will be selected by the CxA.
2. Controls contractor shall provide an as-built shop drawing to the CxA for use in executing FPT.
3. All of the user graphics interfaces and displayed operating points will be demonstrated for the CxA by the control's contractor.
4. Controls contractor shall manipulate the system to demonstrate that it performs all of the specified modes of operation.
5. Points selected by the CxA will be trended for 1-2 weeks by the controls contractor to verify control operation and response. System to in auto without alarms.
6. Site observations will be performed as outlined in the Commissioning Activity Schedule (see Exhibit A).

C. Electrical Systems

1. During the installation the CxA will perform the following for the electrical systems:
 - a. Periodically observe the installation of equipment.
 - b. Review the completed Pre-functional Checklists (PFC).
 - c. Verify the PFC's by observing the completed work and comparing to the values listed in the PFC.
 - d. Review the factory authorized programming and checkout report of the lighting control panels and devices.

- e. The contractor is to provide NETA certified third party testing of the power distribution system and provide the CxA with a certified test report.
 - f. CxA will review contractor provided as-builts for proper identification and labeling of all equipment, piping and devices.
2. To test the performance of the lighting control system the CxA will perform the following tasks:
 - a. Witness the contractor testing each scene from each wall station.
 - b. Verify these scenes match the design intent from the contract documents.
 - c. Witness the contractor testing the integration to the other integrated systems such as audio visual and monitoring abilities from the BMS.
 - d. Verify this integration allows control and/or monitoring from the other systems.
 - e. Verify connectivity to the emergency lighting circuits.
 - f. Witness the contractor testing the emergency lighting circuits.
 3. Upon completion of the emergency power system, factory start-up and contractor pretesting, the CxA will witness a contractor test to verify complete system power loss and verify proper power provision of critical systems. The test will not be scheduled until all other systems dependent on emergency power have been tested and approved.
- D. Plumbing
1. Domestic hot water will be tested by the CxA by measuring the hot water temperature at a percentage of the fixtures along with the time it takes to reach that temperature.
 2. Contractor shall demonstrate domestic hot water boilers, pumps and controls through all modes of operation and alarms.
 3. After contractor has adjusted all fixtures for proper flush and sink fixture metering, the CxA will test plumbing fixtures for proper operation.
- E. Irrigation
1. The CxA will witness the contractor demonstration of the irrigation controller and coverage using the contractor's as-built drawings.

Exhibit A

Commissioning Activity Schedule								
GCs Completion Schedule Activity ID	Commissioning (Cx) Construction Phase Activity		Building System			Parallel Construction Site Activity	Duration of Cx Activity	CxA Required Site Visit
				MEPCx				
1	Cx Kick-off Meeting		•		Contractor mobilized onsite	1 day	•	
2	CxA provided jobsite Cx Site Binder including Pre-Functional Checklists		•		CM and or GC to receive Cx Site Binder from CxA during Cx Kick-off Meeting	-		
3	CxA identifies submittals required for Cx		•		Contractor provides a submittal list for CxA to review and highlight required submittals to be reviewed for Cx	-		
4	CxA reviews submittals		•		A/E reviews submittals	TBD		
5	CxA begins to receive O & M Manuals		•		Subcontractors provides O & M Manuals to Contractor	TBD		
6	Mechanical equipment site verification, update Cx Equipment List & update Cx Issues Log		•		Mechanical equipment set	1 day	•	
7	CxA to start development of Cx Functional Test Checklists		•		Submittal reviews complete	-		
8	CxA notified that permanent power is installed		•		Permanent power installed	-		
9	CxA receives copies of the field Air Duct Leakage Testing Report		•		Air duct leakage testing completed	-		
10	CxA conducts onsite functional testing procedures coordination meeting with CM, GC, and MEP subcontractors		•		1 month prior to Cx Functional Testing	1 day	•	
11	CxA issues Functional Test Checklists to CM, GC, and MEP subcontractors		•		1 Month prior to Cx Functional Testing	-		
12	CxA Witnesses startup of HVAC equipment		•		HVAC contractor meets CxA onsite for startup	-		
13	CxA receives jobsite Pre-Functional Checklists from Cx Site Binder completed, signed and dated		•		2 Weeks prior to Cx Functional Testing	-		
14	Building LEED flush-out schedule received by CxA		•		CM or GC coordinates LEED flush-out schedule with Cx functional testing activities	TBD		

Commissioning Activity Schedule								
GCs Completion Schedule Activity ID	Commissioning (Cx) Construction Phase Activity		Building System			Parallel Construction Site Activity	Duration of Cx Activity	CxA Required Site Visit
				MEPCx				
15	CxA receives field TAB Report		•			1 Week prior to Cx Functional Testing	-	
16	CxA receives completed/signed Systems Functional Testing Readiness Certification and Notification Letter for Commissioning indicating TAB, BMS, HVAC, domestic hot water, lighting controls, and irrigation control systems are ready for Cx Functional Testing		•			1 Week prior to Cx Functional Testing	-	
17	Start functional testing on TAB, BMS, HVAC, domestic hot water, lighting controls, and irrigation control systems		•			CM and or GC sent CxA the following functional testing prerequisites: a. CxA received signed notification letter that TAB, BMS (including all graphics), HVAC, domestic hot water, and lighting controls and irrigation control systems are completed and ready for Cx functional testing. b. Pre-functional checklist completed and signed. c. CxA received TAB report	4 days total days of items 18 thru 23	•
18	Cx verification of the TAB report air and water values		•			TAB subcontractor meets CxA onsite to verify TAB report	1/2 day	•
19	Cx of BMS		•			Controls subcontractor meets CxA onsite to perform Functional Testing of BMS after BMS point-to-point & checkout is completed	1/2 day	•
20	Cx of HVAC		•			Controls contractor and HVAC contractor meets CxA onsite to perform functional testing of HVAC	1 1/2 days	•
21	Cx of domestic hot water		•			Plumbing subcontractor meets CxA onsite to perform functional testing of domestic hot water	1/2 day	•

Commissioning Activity Schedule								
GCs Completion Schedule Activity ID	Commissioning (Cx) Construction Phase Activity		Building System			Parallel Construction Site Activity	Duration of Cx Activity	CxA Required Site Visit
				MEPCx				
22	CxA of lighting controls			•		Electrical lighting controls contractor and electrical contractor meets CxA onsite to perform functional testing of lighting controls	1/2 day	•
23	CxA of irrigation controls			•		Landscaping contractor meets CxA onsite to perform functional testing of irrigation controls	1/2 day	•
24	CxA receives building systems owner training agenda's and training schedule			•		Cx functional testing completed	-	
25	CxA confirms all Cx issues are resolved			•		CM receives responses addressing Cx issues	TBD	
26	Cx Report			•		Cx systems testing completed	14 days	
27	Cx Systems Manual			•		Cx systems O & M Manuals sent to CxA	14 days	

Schedule Notes:

The following sequential priorities are required to be followed:

1. Equipment is not “temporarily” started (for heating or cooling), until pre-start checklist items and all manufacturer’s pre-start procedures are completed, dirt, dust and other environmental and building integrity issues have been addressed.
2. Functional performance testing does not begin until Pre-Functional, start-up and TAB is completed for a given system.
3. The controls systems and equipment under its control is not functionally tested until all points have been calibrated and Pre-Functional Checklists are completed.

Exhibit B

*Systems Functional Testing Readiness Certification and
Notification Letter for Commissioning*

*Las Positas Community College Horticulture Facility
3000 Campus Hill Drive, Livermore, CA 94551*

This letter shall serve as certification to 3QC that all applicable systems checked below have been fully tested to perform as specified in the Construction Documents, in accordance with 3QC’s Functional Testing Checklists, and that all functional testing prerequisites as outlined in the Commissioning Specifications and Commissioning Plan have been completed and submitted to 3QC for review. 3QC is hereby officially notified to begin onsite functional testing of the following systems:

Systems Ready for Functional Testing by 3QC <i>(Completed by General Contractor or CM at Risk <u>as systems become available</u> and are ready for testing – meeting all criteria explained here within)</i>		
Check Applicable System	Systems	Date GC is Requesting for CxA on-site Functional Testing **
<input type="checkbox"/>	TAB Verification	
<input type="checkbox"/>	BMS, BAS, DDC or EMS	
<input type="checkbox"/>	HVAC Systems	
<input type="checkbox"/>	Plumbing Systems	
<input type="checkbox"/>	Lighting Control Systems	
<input type="checkbox"/>	Irrigation	

**** = Systems Technician Required** – The contractor certifies that a systems technician familiar with and capable of operating each system to be commissioned will be available onsite throughout functional testing by 3QC. For BMS, BAS, DDC or EMS systems this must be the commissioning technician/programmer.

Failed Functional Testing – If 3QC arrives onsite, on the date indicated above, for functional testing which cannot be completed due to systems readiness failure, systems technician no-show, or other circumstances not caused by 3QC resulting in failed functional testing; it is understood that 3QC’s client (listed below) will be invoiced for expenses incurred by 3QC. The contractor also agrees to reimburse said client for incurred expenses. 3QC expenses will be invoiced as follows:

- Travel expenses as applicable
- \$2,500/day for each on-site 3QC CxA

Signature of 3QC’s Client or Representative	Print Name	Date
---	------------	------

Signature of General Contractor or CM at Risk	Print Name	Date
---	------------	------

END OF SECTION

SECTION 02 3200

GEOTECHNICAL INVESTIGATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. A Geotechnical Evaluation & Geologic Hazards Assessment report has been prepared by Ninyo & Moore, Geotechnical & Environmental Sciences Consultants, dated October 10, 2019.
- B. Use of data:
 - 1. The soils report was prepared for the use in design and is a part of the Contract Documents.
 - 2. The report is included for bidders' information, but is not a warranty of subsurface conditions.
 - 3. Bidders are encouraged to visit the site and acquaint themselves with existing conditions.
- C. Related Sections:
 - 1. Section 03 3000, Cast-In-Place Concrete.
 - 3. Section 31 1000, Site Preparation and Demolition.
 - 4. Section 31 2000, Earthwork and Grading.
 - 5. Section 32 1313, Site Concrete.
 - 6. Division 22, Plumbing.
 - 7. Division 23, Heating, Ventilating, and Air Conditioning.
 - 8. Division 26, Electrical.

1.2 QUALITY ASSURANCE

- A. A soil engineer will be retained by the Owner to observe performance of work in connection with excavating, trenching, filling, backfilling, and grading, and to perform compaction tests.
- B. Correct work performed that does not meet technical or design requirements at no cost to the Owner.

END OF SECTION

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Geotechnical Evaluation & Geologic Hazards Assessment

Agricultural Sciences – Horticulture Facility
3000 Campus Hill Drive
Livermore, California

Chabot Las Positas Community College District
7600 Dublin Boulevard | Dublin, California 94568

March 31, 2020 | Project No. 401294035



Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

March 31, 2020
Project No. 401294035

Ms. Ann Kroll
Project Planner, Manager/Facilities Bond Program
Las Positas College
3000 Campus Hill Drive
Livermore, California 94551

Subject: Geotechnical Evaluation and Geologic Hazards Assessment
Agricultural Sciences – Horticulture Facility
3000 Campus Hill Drive
Livermore, California

Dear Ms. Kroll:

In accordance with your authorization, we have performed a geotechnical evaluation and geologic hazards assessment for the proposed Agricultural Sciences – Horticulture Facility (AS-HF) at Las Positas College in Livermore, California. This report presents the findings from our evaluation, the conclusions from our assessment, and our geotechnical recommendations regarding the proposed project.

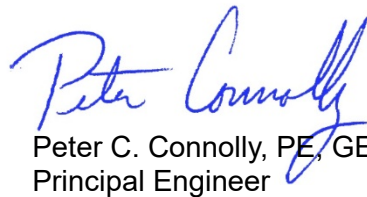
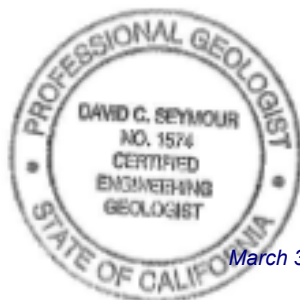
As an integral part of our role as the geotechnical engineer-of-record, we request the opportunity to review the construction plans before they go to bid and to provide follow-up construction observation and testing services.

Ninyo & Moore appreciates the opportunity to be of service to you on this project.

Sincerely,
NINYO & MOORE



David C. Seymour, PG, CEG
Principal Engineering Geologist



Peter C. Connolly, PE, GE
Principal Engineer

PCC/DCS/gvr

Distribution: (1) Addressee (via e-mail)

March 31, 2020



March 31, 2020

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1 INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a Geotechnical Evaluation & Geologic Hazards Assessment for the proposed Agricultural Sciences – Horticulture Facility (AS-HF) on the campus of Las Positas College at 3000 Campus Hill Drive in Livermore, California (Figure 1). The purpose of our study was to evaluate the potential geologic hazards and geotechnical conditions at the project site, and provide recommendations for the design and construction of the project improvements.

During the course of our evaluation, the project site was relocated to an area just east of the original site location (Figure 2). As a result, our field exploration was conducted in two different phases. Data collected during both phases is included herein.

2 SCOPE OF SERVICES

Our scope of services included the following:

- Review of readily available geologic literature pertinent to the project area including geologic maps and reports.
- Site reconnaissance to observe the general site conditions and mark the proposed locations for subsurface exploration.
- Coordination with Underground Service Alert to locate the underground utilities in the vicinity of the proposed exploration locations.
- A private utility survey to check the exploration locations for underground utility conflicts.
- Procurement of a boring permit from the Zone 7 Water Agency.
- Subsurface evaluation consisting of drilling, logging, and sampling of eleven solid stem auger borings. A representative of Ninyo & Moore logged the subsurface conditions exposed in the borings, and collected bulk and relatively undisturbed samples for laboratory testing. The exploratory borings were backfilled in accordance with the requirements of the Zone 7 Water Agency.
- Performance of a Refraction Microtremor (ReMi) survey to evaluate subsurface variations in shear wave velocity to determine the seismic site classification.
- Percolation testing at one location to evaluate the infiltration characteristics of the near-surface soils for design of a storm water management system.
- Laboratory testing on selected soil samples to evaluate in-place soil moisture content and density, particle size distribution, Atterberg limits, expansion index, and soil corrosivity as appropriate for the subsurface materials encountered.

- Engineering analysis of the gathered data to evaluate geotechnical considerations for the proposed improvements, including seismic parameters, liquefaction potential, foundation design criteria, and earthwork guidelines.
- Preparation of this geotechnical report presenting our findings regarding the geotechnical conditions encountered at the project site, the conclusions from our geologic hazards assessment, and our recommendations for the design and construction of the project.

3 SITE DESCRIPTION AND BACKGROUND

The Las Positas Community College campus is an irregularly-shaped parcel covering approximately 147 acres located at 3000 Campus Hill Drive in Livermore, California (Figure 1). The campus is located approximately 3,000 feet north of Highway 580 and east of Collier Canyon Road. The proposed project site is located at approximately 37.7157° north latitude and 121.7944° west longitude on the Livermore 7.5-minute topographic quadrangle (USGS, 2018).

The currently proposed location for the agricultural sciences and horticulture facility project is in the northeastern portion of the campus, north of the athletic field and east of the maintenance and operations facility (Figure 2). The site is bounded to the north, east, and south by open space, and to the west by a raised pad area where several shipping containers are located. The previously proposed location is just north of the raised pad with shipping containers (Figure 2). The site is relatively flat with elevations varying from approximately 540 to 545 feet above mean sea level (MSL) (Sandis, 2019). Stockpiles of soil and debris are present over portions of the site. Existing vegetation on site generally consists of low grasses and weeds, and most of the surface has been plowed to control vegetation growth.

The proposed site has been modified by previous earthwork construction and is underlain by engineered fill placed under the observation and testing of Ninyo & Moore (2011). Mass grading of the site was performed between October 2009 and September 2010. Earthwork operations included processing of the subgrade soils prior to fill placement, and compaction of engineered fills to 95 percent relative compaction. Due to plowing and other activities, the upper 12 inches of the surface are disturbed.

4 PROJECT DESCRIPTION

Based upon the project plans prepared by ATI Architects and Engineers (2020), the project will consist of a 2,100 square foot classroom building, a 2,000 square foot greenhouse, a 300 square foot equipment storage unit with an adjoining 3-car garage, a shade house, a parking lot, an orchard and growing ground. The proposed locations of these improvements are depicted on

Figure 2. We anticipate that finish grades will be within a foot or so of the existing flat portions of the site and that existing stockpiles will be removed.

5 FIELD EXPLORATION AND LABORATORY TESTING

Our field exploration for this study included a site reconnaissance and subsurface exploration conducted on November 13, 2019 and March 3, 2020. The subsurface exploration consisted of eleven auger borings and one percolation test. Borings B-1 through B-6 were drilled for the original site location, while Borings B-7 through B-11 were drilled for the revised location, which is the subject of this report. The approximate locations of the exploratory borings and percolation test are shown on Figure 2.

Prior to commencing the subsurface exploration, we contacted Underground Service Alert (USA) to notify utility owners and retained a private utility locator to locate and mark existing utilities on site. The exploratory borings were drilled to depths of up to approximately 25 feet below the ground surface using a truck-mounted rig equipped with solid-stem augers. A representative of Ninyo & Moore logged the subsurface conditions exposed in the borings and collected relatively undisturbed and bulk soil samples from the borings. The samples were transported to our geotechnical laboratory for testing. The borings were backfilled with grout after drilling in conformance with the Zone 7 permit. Descriptions of the subsurface materials encountered are presented in the following sections. Detailed logs of the borings are presented in Appendix A.

Laboratory testing of soil samples recovered from the borings included tests to evaluate in-situ soil moisture content and dry density, particle size distribution, Atterberg limits, expansion index, and soil corrosivity. The results of the in-situ moisture content and dry density tests are presented on the boring logs in Appendix A. The results of the other laboratory tests are presented in Appendix B.

A percolation test was performed on November 13, 2019 at the location shown on Figure 2. The percolation test results and procedures utilized are presented in Appendix C. The test hole was backfilled with the soil cuttings after testing.

A geophysical Refraction Microtremor (ReMi) survey was performed at the site on February 1, 2020. The purpose of the study was to evaluate the subsurface shear-wave velocity at the site in order to select the appropriate seismic site class. The ReMi survey used the passive seismic method of Microtremor Array Measurements (MAM) and consisted of one linear profile of seismic data collection as shown on Figure 2. The method provided a shear wave velocity model to a depth of approximately 100 feet which was then used to calculate the weighted harmonic mean

of the shear wave velocity (V_{s100}) over that interval to select the seismic site class. The seismic model results are provided in Appendix D.

6 GEOLOGIC AND SUBSURFACE CONDITIONS

6.1 Regional Geologic Setting

The site is located east of San Francisco Bay in the Coast Ranges geomorphic province of California. The Coast Ranges are comprised of several mountain ranges and structural valleys formed by tectonic processes commonly found around the Circum-Pacific belt. Basement rocks have been sheared, faulted, metamorphosed, and uplifted, and are separated by thick blankets of Cretaceous and Cenozoic sediments that fill structural valleys and line continental margins. The San Francisco Bay area has several ranges that trend northwest, parallel to major strike-slip faults such as the San Andreas, Hayward, and Calaveras (Figure 3). Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement.

6.2 Site Geology

Regional maps (Dibblee & Minch, 2006; Graymer et al, 1996) indicate that the project site is underlain by the Livermore Gravel of Pliocene to Pleistocene age. The Livermore Gravel is described as poorly to moderately consolidated, indistinctly bedded, cobble conglomerate, gray conglomeratic sandstone, and gray coarse-grained sandstone with some siltstone and claystone (Graymer et al, 1996). A regional geologic map prepared by Dibblee & Minch (2006) is provided as Figure 4. This unit is described as alluvium on the boring logs in this report.

6.3 Subsurface Conditions

The following sections provide a generalized description of the units encountered during our subsurface evaluation. More detailed descriptions are presented on the boring logs in Appendix A. Cross sections depicting our interpretation of the subsurface geologic conditions are provided on Figures 5 and 6.

6.3.1 Artificial Fill

Artificial fill placed under the geotechnical observation and testing of Ninyo & Moore (2011) was observed in borings B-7 through B-11, which were drilled for the revised site location. The engineered fill encountered in these borings ranged in thickness from 5 feet to over 15 feet and generally consisted of layers of brown, dark brown and olive brown, dry to moist, stiff to very stiff lean clay, and medium dense clayey sand. The upper foot or so of the fill has

been disturbed by plowing and is considered unsuitable for support of foundations and other improvements.

Soil stockpiles up to approximately 5 feet in height are also present over portions of the site. These stockpiles generally consist of lean clay and organic material. These fill materials were placed during previous construction activities and are considered undocumented and unacceptable for support of structures and pavement.

6.3.2 Alluvium

Alluvium was encountered in our borings from below the fill to the depths explored. As encountered, the alluvium generally consisted of light to dark brown and olive brown, moist, very stiff to hard, lean and fat clay.

6.4 Groundwater

Groundwater was not encountered during our subsurface exploration. The California Geological Survey (CGS) indicates that the project site is within an area where information regarding the depth to historical high groundwater level is uncertain (CGS, 2008a).

Fluctuations in the level of groundwater may occur due to variations in ground surface topography, subsurface stratification, rainfall, irrigation practices, groundwater pumping, and other factors which may not have been evident at the time of our field evaluation. In addition, seeps may be encountered at elevations above the groundwater levels encountered due to perched groundwater conditions, leaking pipes, preferential drainage, or other factors not evident at the time of our exploration.

7 GEOLOGIC HAZARDS AND CONSIDERATIONS

This study considered a number of potential issues relevant to the proposed construction on the subject site, including seismic hazards, landsliding, flood hazards, settlement of compressible soil layers, unsuitable materials, expansive soil, naturally occurring asbestos, potential for on-site soil to corrode ferrous metals and promote sulfate attack on concrete, excavation considerations, and infiltration characteristics. These issues are discussed in the following subsections.

7.1 Seismic Hazards

The project site is in a region considered to be seismically active. The seismic hazards considered in this study include the potential for ground surface fault rupture and ground shaking due to seismic activity, liquefaction, dynamic settlement, seismic slope stability, tsunamis, and seiches. These potential hazards are discussed in the following subsections.

7.1.1 Historical Seismicity

The site is located in a seismically active region. Figure 3 presents the location of the site relative to the epicenters of historic earthquakes with magnitudes of 5.5 or more from 1800 to 2000. Records of historic ground effects related to seismic activity (e.g. liquefaction, sand boils, lateral spreading, ground cracking, etc.) compiled by Knudsen et al. (2000), indicate that no ground effects related to historic seismic activity have been reported for the site.

7.1.2 Faulting and Ground Surface Rupture

There are numerous recognized faults in northern California. Selected characteristics, as evaluated by the Working Group on California Earthquake Probabilities (WGCEP, 2013), for recognized and postulated faults (Caltrans, 2019) near the site are presented in Table 1. The fault characteristics in the table are presented in order of decreasing peak ground acceleration (PGA) based on a deterministic seismic hazard analysis.

Table 1 – Parameters for Nearby Faults

Fault (Segment)	ID	Type	Max Moment Magnitude	Distance to Site (kilometers)
Greenville (North) 2011 CFM	131	Strike Slip	6.9	6.8
Mount Diablo Thrust	129	Reverse	6.6	8.6
Pleasanton fault	135	Strike Slip	6.6	9.2
Calaveras (North) 2011 CFM	130	Strike Slip	6.9	12.1
Las Positas	141	Strike Slip	6.4	8.3
Clayton	125	Strike Slip	6.9	16.8
Great Valley 06 (Midland) alt2	116	Reverse	6.8	17.9
Hayward (South)	137	Strike Slip	7.3	22.8
Greenville (South) 2011 CFM	144	Strike Slip	6.9	18.3
Great Valley 07 (Orestimba)	138	Reverse	6.7	20.1

The site is not located within an Alquist-Priolo Fault Rupture Hazard Zone (AP Zone) established by the State Geologist (CGS, 1982) to delineate regions of potential ground surface rupture adjacent to active faults. As defined by the California Geological Survey (CGS), active faults are faults that have caused surface displacement within Holocene time,

or within approximately the last 11,700 years (CGS, 2018). The closest fault rupture hazard zone is the one associated with the Greenville Fault, which is approximately 4¼ miles northeast of the site.

Regional geologic maps by Crane (1995), Dibblee and Minch (2006), Graymer et al. (1996), and Jennings and Bryant (2010) depict a fault within approximately 100 feet of the project site to the northwest (Figure 4). The nearest proposed structures intended for human occupancy include the classroom building and greenhouse, which are located approximately 200 feet southeast of the mapped fault trace. Jennings & Bryant (2010) refer to this fault, perpendicular and north of the Livermore fault, as a Quaternary fault with evidence of displacement in the last 1.6 million years. Graymer et al. (1996), Crane (1995), and Majmunder (1991) interpret the fault as a thrust feature, with the hanging wall to the north of the fault trace, while Dibblee & Minch (2006) indicate that the north side of the fault is moving up relative to the south side. Detailed mapping by Dibblee & Minch (2006) and Majmunder (1991) indicates that the fault is exposed in the Pliocene to Pleistocene Livermore Gravels, but is generally concealed by Holocene alluvium. Based upon the information presented above, the fault located approximately 100 feet northwest of the project site would not be considered active for purposes of potential surface fault rupture with low probability of damage to structures due to surface rupture for this fault.

Additionally, Ninyo & Moore performed a subsurface fault trenching study in 2007 to evaluate if northwest-trending lineaments observed in aerial photographs as projecting onto the Las Positas Community College Campus were related to faulting. No evidence of faulting was found within the approximately 660-foot-long trench that was excavated across these lineaments (Ninyo & Moore, 2007).

Based on our review of the referenced geologic maps and the results of our previous fault trenching study, known active faults are not mapped on the site and the site is not located within a fault-rupture hazard zone. Therefore, the probability of damage from surface fault rupture is considered to be low.

7.1.3 Strong Ground Motion

Considering the proximity of the site to active faults capable of producing a maximum moment magnitude of 6.0 or more, the project area has a high potential for experiencing strong ground motion. Seismic design criteria to address ground shaking are provided in Section 9.1. A site-specific ground motion hazard analysis was performed in accordance with Chapter 21 of the American Society of Civil Engineers (ASCE) Standard 7-16 to evaluate the peak ground

acceleration (PGA) associated with the Maximum Considered Earthquake Geometric Mean (MCE_G) in accordance with the 2019 California Building Code (CBC). The site-specific ground motion analysis consisted of a probabilistic seismic hazard analysis (PSHA) using the Open Seismic Hazard Analysis (OpenSHA) Hazard Spectrum Application (Field et al., 2003) and a deterministic seismic hazard analysis (DSHA) using 2014 next generation attenuation (NGA) relationships (Seyhan, 2015). The earthquake rupture forecast considered in the analysis and the specific attenuation relationships utilized are listed on Figure 7. An average shear wave velocity of 984 feet per second (fps) to a depth of 100 feet (V_{s100}), based on the results of the geophysical survey for this study (Appendix D), was assumed for this analysis with a corresponding Class D seismic site classification. Basin characteristics were interpreted from Version 8.3.0 of the USGS Bay Area Velocity Model using the OpenSHA Site Data Application (Field et al., 2003). Assumed fault characteristics (Caltrans, 2019) and site-to-rupture distances are listed in Table 1. Our analysis indicates that the DSHA is controlled by either a magnitude 6.9 event on the Greenville fault with a site-to-rupture distance of about 6.8 kilometers or a magnitude 6.6 event on the Mount Diablo Thrust fault with a site-to-rupture distance of about 8.6 kilometers. The results of our site-specific ground motion hazard analysis indicate that the MCE_G peak ground acceleration with adjustment for site class effects (PGA_M) is 0.701g. Ground motion calculations are presented in Appendix E.

7.1.4 Liquefaction and Strain Softening

The strong vibratory motions generated by earthquakes can trigger a rapid loss of shear strength in saturated, loose, granular soils of low plasticity (liquefaction) or in wet, sensitive, cohesive soils (strain softening). Liquefaction and strain softening can result in a loss of foundation bearing capacity or lateral spreading of sloping or unconfined ground. Liquefaction can also generate sand boils leading to subsidence at the ground surface.

The site is not located within a seismic hazard zone for liquefaction (Figure 8) as mapped by the California Geological Survey (CGS, 2008). Moreover, we did not encounter saturated, loose, granular soils during our subsurface exploration. The fine-grained soil (silt and clay) encountered during our subsurface exploration generally did not conform to the characteristics of liquefiable soils published by Bray and Sancio (2006). The cohesive soils encountered were not particularly wet or sensitive. As such, we do not regard liquefaction, strain softening, or related hazards including lateral spreading or sand-boil induced ground subsidence as design considerations.

7.1.5 Dynamic Settlement

The strong vibratory motion associated with earthquakes can also dynamically compact loose granular soil leading to surficial settlements. Dynamic settlement is not limited to the near-surface environment and may occur in both dry and saturated sand and silt. Cohesive soils are not typically susceptible to dynamic settlement.

Based on the generally stiff to hard consistency and cohesive nature of the on-site materials, we do not regard dynamic settlement as a design consideration.

7.1.6 Seismic Slope Stability

The site is not located within a hazard zone for earthquake-induced landslides on the Seismic Hazard Zones Map (Figure 8) prepared by the CGS (2008). As such, we do not regard seismic slope stability as a design consideration.

7.1.7 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to ocean depth) generated by the sudden movements of the ocean floor during submarine earthquakes, landslides, or volcanic activity. The project location is not within a tsunami inundation area as shown on the Tsunami Inundation Map for Emergency Planning Map (State of California, 2009). Seiches are waves generated in a large enclosed body of water. Based on the inland location of the site, and the lack of a large body of water nearby, the potential for damage due to tsunamis or seiches is not a design consideration.

7.2 Flood Hazards

Our review of Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FEMA, 2009) indicates that the project site is outside the 500-year flood zone (Zone X). As such, the potential for flooding at the site is low.

7.3 Landsliding and Slope Stability

The site of the proposed project and surrounding area is relatively flat and the proposed grading does not include the construction of significant slopes. Based on the topographic site conditions and the proposed grading, we do not regard landsliding or slope stability as a design consideration.

7.4 Unsuitable Materials

Fill materials that were not placed and compacted under the observation of a geotechnical engineer, or fill materials lacking documentation of such observation, are considered to be undocumented fill and unsuitable as a bearing material below foundations due to the potential for differential settlement resulting from variable support characteristics or the potential inclusion of deleterious materials. The upper foot or so of the engineered fill (Ninyo & Moore, 2011) has been disturbed by plowing and is considered unsuitable for support of foundations and other improvements. Recommendations for remedial grading to mitigate the unsuitable support characteristics of the disturbed fill materials are presented later in this report.

Soil containing roots or other organic matter are not suitable as fill or subgrade material below structures, walls, pavements, flatwork, or engineered fill. Stockpiles of soil with organic matter are present over portions of the site. The stockpiled soil is undocumented fill and, in the current state, is unsuitable as a bearing material below structures or additional fill. These stockpiles and other surficial soil containing roots or other organic matter should be removed as part of the clearing and grubbing operations.

7.5 Static Settlement

No significant increase in pad elevations are anticipated for the project and the subsurface conditions encountered in our borings, below the upper foot or so of disturbed fill, generally consisted of stiff to hard clay. We estimate that static settlement will be approximately ½ inch for sustained wall and column loads of up to 6 kips per foot and 100 kips, respectively, with footings and pad grading that conform to the recommendations in this report.

7.6 Naturally Occurring Asbestos

Natural occurrences of asbestos are more likely to be encountered in, and immediately adjacent to, outcrops of ultramafic rocks. Ultramafic rock was not encountered during our subsurface exploration. Regional mapping by Churchill and Hill (2000) indicate that no ultramafic rocks have been mapped in the general vicinity of the project site. Therefore, it is unlikely that significant concentrations of naturally occurring asbestos will be encountered at the site.

7.7 Expansive Soil

Some clay minerals undergo volume changes upon wetting or drying. Unsaturated soil containing those minerals will shrink/swell with the removal/addition of water. The heaving pressures associated with this expansion can damage structures and flatwork. Laboratory testing was

performed on samples of the near-surface soil to evaluate the expansion index. The tests were performed in accordance with the American Society of Testing and Materials (ASTM) Standard D 4829 (Expansion Index). The results of our laboratory tests indicate that the expansion index of the samples tested from near surface soil in the vicinity of the proposed buildings ranged from 53 to 74. These results are indicative of a medium expansion characteristic. The results of the expansion index testing are presented in Appendix B.

Additional testing was performed in accordance with ASTM D 4318 to evaluate the liquid limit, plastic limit, and plasticity index of selected samples. The test results, presented in Appendix B, indicate that the plasticity index of samples collected at depths ranging from approximately 2.5 to 20 feet below the ground surface ranged from 23 to 45. These results are indicative of soil with a medium to very high expansion characteristic.

To reduce the potential for heave and differential movement due to shrink/swell behavior, recommendations are provided for remedial grading with select import fill or chemical-treatment of on-site soil to create a zone of material with low expansion characteristics below buildings and flatwork.

7.8 Corrosive Soil

An evaluation of the corrosivity of the on-site material was conducted to assess the impact to concrete and metals. The corrosion impact was evaluated using the results of limited laboratory testing on samples obtained during our subsurface study. Laboratory testing to quantify pH, resistivity, chloride content, and soluble sulfate content was performed on samples of the near-surface soil. The results of the corrosivity tests are presented in Appendix B.

California Department of Transportation (Caltrans) defines a corrosive environment for structures as an area where the soil has a chloride concentration of 500 parts per million (ppm) or greater, soluble sulfate concentration of 0.15 percent (1,500 ppm) or greater, or a pH of 5.5 or less (Caltrans, 2018). The criteria used to evaluate the deleterious nature of soil on concrete are listed in Table 2. Based on these criteria and the results of our testing, the near-surface soil at the site meets the definition of a corrosive environment for structures, and the sulfate exposure to concrete is severe with an exposure classification for sulfate of S2. Recommendations to mitigate the impact of corrosive soil on concrete structures are presented in Section 9.6.

Table 2 – Criteria for Deleterious Soil on Concrete

Sulfate Content Percent by Weight	Sulfate Exposure	Exposure Class
0.0 to 0.1	Negligible	S0
0.1 to 0.2	Moderate	S1
0.2 to 2.0	Severe	S2
> 2.0	Very Severe	S3

Reference: American Concrete Institute (ACI) Committee 318 Table 19.3.1.1 (ACI, 2016)

7.9 Infiltration Characteristics

Ninyo & Moore performed percolation testing to evaluate the rate of infiltration on site for design of storm water management systems. The percolation test procedures utilized are presented in Appendix C. The test results, presented in Appendix C and summarized in Table 3, indicate that the infiltration rate of the near surface soil on site is relatively slow. Due to the variability of subsurface materials encountered during our exploration, variability in subsurface infiltration should be anticipated.

Table 3 – Percolation Test Results

Test	Test Depth	Subsurface Conditions	Percolation Rate	Infiltration Rate ^[1]
P-1	2.5 feet	Lean Clay	1.0 inch/hour	0.3 inches/hour

Note:

1 Infiltration rate is percolation rate adjusted by a reduction factor to exclude percolation through sides of test hole.

7.10 Excavation Considerations

We anticipate that the proposed project may involve excavations of up to several feet for footings, utility trenches, and remedial grading. The geologic units encountered over this interval during our subsurface evaluation included engineered fill that generally consisted of stiff to very stiff clay and medium dense clayey sand. We anticipate that heavy earthmoving and drilling equipment in good working condition should be able to make the proposed excavations. Excavations in the fill may encounter debris, rubble, oversize material, buried objects, or other potential obstructions.

Near-vertical temporary cuts in these deposits up to 4 feet in depth should remain stable for a limited period of time. Sloughing of the sidewalls may occur particularly if the excavation encounters granular soil or seeping conditions, is exposed to water, or if the sidewalls are disturbed during construction operations. Excavation subgrade may become unstable if exposed to wet conditions. Appropriate temporary slopes or shoring may be needed to stabilize excavation sidewalls. Recommendations for excavation stabilization are presented.

8 CONCLUSIONS

Based on our review of the referenced background data, site field reconnaissance, subsurface evaluation, and laboratory testing, it is our opinion that the proposed construction is feasible from a geotechnical standpoint. Geotechnical considerations include the following:

- The subsurface exploration for this study encountered engineered fill (Ninyo & Moore, 2011) and alluvium. The fill, as encountered in the borings for this study, generally consisted of stiff to very stiff lean clay and medium dense clayey sand. The upper foot or so of the fill was loose/soft as a result of disturbance by plowing. The alluvium underlying the engineered fill generally consisted of very stiff to hard, lean and fat clay.
- Groundwater was not encountered during our subsurface exploration. Variations in the groundwater level across the site and over time should be anticipated.
- The site could experience a relatively large degree of ground shaking during a significant earthquake on a nearby fault.
- The project site is outside the 500-year flood zone.
- Tsunamis, seiches, landslides, slope stability, and ground surface rupture due to faulting are not design considerations based on the location of the project.
- Dynamic settlement, seismic strain softening, liquefaction and related hazards are not design considerations based on the subsurface conditions encountered.
- We estimate that static settlement will be approximately ½ inch for the proposed improvements on footings with site preparation and pad grading to remove existing stockpiles of undocumented fill and mitigate the upper layer of loose/soft fill disturbed by plowing.
- Laboratory testing indicates that soil with a high to very high expansion characteristic is present on site. Recommendations for remedial grading are provided to mitigate the potential impact of expansive soils.
- It is unlikely that significant concentrations of naturally occurring asbestos will be encountered at the site based on the site location and the subsurface conditions encountered.
- Our laboratory corrosion testing indicates that the site soil meets the definition of a corrosive environment for structures based on California Department of Transportation (Caltrans, 2018) corrosion guidelines.
- Percolation testing performed for this study indicate that the infiltration rate at the test hole (Figure 2) is relatively slow.
- Excavations in the fill may encounter debris, rubble, oversize material, buried objects, or other potential obstructions.
- Excavations that remain unsupported and are exposed to water or encounter granular soil may be unstable and prone to sloughing. Recommendations for excavation stabilization are provided.

9 RECOMMENDATIONS

The following sections present our geotechnical recommendations for the design and construction of the proposed improvements. The project improvements should be designed and constructed in accordance with these recommendations, applicable codes, and appropriate construction practices.

9.1 Seismic Design Criteria

Ninyo & Moore performed a site-specific ground motion analysis in accordance with the procedure in Chapter 21 of ASCE Standard 7-16. The assumptions and methodology for this analysis are discussed in Section 7.1.3. Seismic Site Class D was selected based on the results of the geophysical survey performed for this study (Appendix D). The design response spectrum based on the site-specific ground motion analysis is presented on Figure 7 and the corresponding seismic design criteria are summarized in Table 4. Calculations from the analysis are presented in Appendix E.

Table 4 – 2019 California Building Code Seismic Design Criteria

Seismic Design Parameter Evaluated for 37.7157° North Latitude, 121.7944° West Longitude	Site Specific	Section 11.4 ASCE 7-16
Site Class	D	D
Site Coefficient, F_a	---	1.0
Site Coefficient, F_v	---	1.7
Mapped Spectral Response Acceleration at 0.2-second period, S_s	---	1.823g
Mapped Spectral Response Acceleration at 1.0-second period, S_1	---	0.600g
Site-Adjusted Spectral Acceleration at 0.2-second period, S_{MS}	1.696g	1.823g
Site-Adjusted Spectral Acceleration at 1.0-second period, S_{M1}	1.425g	1.020g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	1.131g	1.215g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.950g	0.680g
Seismic Design Category for Risk Category I, II, or III	D	D

The spectral ordinates and seismic coefficients based on the mapped values of the risk-targeted spectral response acceleration, consistent with Section 11.4 of ASCE Standard 7-16, are also presented in the table (SEAOC & OSHPD, 2019). In conformance with the 2019 California Building Code, the spectral ordinates and seismic coefficients consistent with Section 11.4 of ASCE Standard 7-16 may be used for seismic design provided that new structures are designed by the equivalent lateral force (ELF) procedure as per Section 12.8 of ASCE Standard 7-16. Otherwise, the seismic design criteria and design response spectrum consistent with the site-

specific ground motion analysis in Table 4 and Figure 7, respectively, should be used for seismic design per the 2019 California Building Code.

9.2 Foundations

The proposed classroom, greenhouse, and equipment shed/garage may be supported on footings presuming that remedial grading is performed per the recommendations in Section 9.3.4 to mitigate concerns related to unsuitable subgrade materials and expansive soil. Recommendations for footings to support site retaining walls are provided in Section 9.4. Light poles, free-standing canopies, and other minor structures may be supported on drilled piers as an alternative to footings.

Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the appropriate governing jurisdictions and applicable building codes should be considered in design of the structures. The foundation design parameters provided in the following sections are not intended to preclude differential movement of foundations. Minor cracking (considered tolerable) may occur.

9.2.1 Footings

Footings on pads prepared in accordance with the recommendations in Section 9.3.4 may be designed using the criteria listed in Table 5. The geotechnical engineer should observe the footing excavations to evaluate bearing materials and subgrade condition before the exposed subgrade is covered.

Table 5 – Recommended Bearing Design Parameters for Footings

Footing	Sustained Loads	Footing Widths	Bearing Depth ¹	Allowable Bearing Capacity ²	Static Settlement
Wall Footing	6 kips/foot or less	18 inches or more	24 inches or more	2,500 psf	½ inch total ¼ inch differential over 30 feet
Column Footing	100 kips or less	24 inches or more	24 inches or more	2,500 psf	½ inch total ¼ inch differential over 30 feet

Notes:

- 1 Below the adjacent finish grade.
- 2 Net allowable bearing capacity in pounds per square foot with Safety Factor of 3 or more. Allowable bearing capacity may be increased by one-third for wind or seismic alternative basic load combinations.

Structures supported on footings consistent with these recommendations should be designed for the total and differential settlements listed in Table 5 for sustained loads. Footing settlement due to static loads may be further evaluated using a modulus of subgrade reaction. Recommended values for the modulus of subgrade reaction in pounds per cubic inch (pci) are provided in Table 6. The designer may interpolate between the values in the table for intermediate footing widths.

Footing	Footing Width				
	1.5 feet	2 feet	3 feet	5 feet	7 feet
Wall Footing	67 pci	52 pci	39 pci	28 pci	--
Column Footing	--	93 pci	61 pci	40 pci	29 pci

The footings should be reinforced with deformed steel bars as detailed by the project structural engineer. Where footings are located adjacent to utility trenches or other excavations, the footing bearing surfaces should bear below an imaginary plane extending upward from the bottom edge of the adjacent trench/excavation at a 2:1 (horizontal to vertical) angle above the bottom edge of the footing. Footings should be deepened or excavation depths reduced as-needed. Footing bottoms should not be sloped more than 1-unit vertical to 10 units horizontal. Wall footings may be stepped provided that the bearing grade differential between adjacent steps does not exceed 18 inches and the slope of a series of such steps does not exceed 1-unit vertical to 2 units horizontal.

A lateral bearing pressure of 300 psf per foot of depth up to 3,000 psf may be used to evaluate the resistance of footings to lateral loads. The recommended lateral bearing pressure is for level and gently sloping ground conditions where the ground slope adjacent to the foundation is 5 percent or less. The lateral bearing pressure should be neglected to a depth of 12 inches where the ground adjacent to the foundation is not covered by a slab or pavement. The lateral bearing pressure may be increased by one-third for alternative basic load combinations with loads of short duration such as wind or seismic forces. A friction coefficient of 0.35 may be assumed for evaluating frictional resistance to lateral loads. The weight of the material above a plane rising up and away from the bottom edges of the footings at 20 degrees off plumb may be considered, along with the weight of the footing and the material over the footing, when evaluating footing resistance to uplift. A unit weight of 120 pounds per cubic foot (pcf) for soil or aggregate and 150 pcf for normal weight concrete may be assumed for this evaluation.

9.2.2 Drilled Piers

Drilled piers used as foundations for light poles, free-standing canopies, and other minor structures embedded up to 20 feet below grade may be designed for an allowable side friction of up to 600 pounds per square foot (psf) at 60 psf per foot of embedment depth to evaluate resistance to downward axial loads and up to 400 psf at 40 psf per foot depth for upward axial loads. The recommended values for allowable skin friction include a safety factor of 2 for downward loading and 3 for upward loading. The allowable side friction may be increased by one-third for alternative basic load combinations with loads of short duration such as wind or seismic loads. The spacing between adjacent piers should be equivalent to three pier diameters or more to mitigate reduction in axial resistance due to group effects. Structures supported on shallow pier foundations should be designed for a total settlement due to sustained loads of approximately $\frac{1}{4}$ inch with a differential of approximately $\frac{1}{4}$ inch over a horizontal distance of 30 feet.

A lateral bearing pressure of 100 pounds per square foot (psf) per foot depth up to 1,500 psf may be used to evaluate resistance to lateral loads and overturning moments in accordance with Section 1806 of the California Building Code with a one-third increase for wind or seismic loading conditions. The allowable lateral bearing pressure may be increased by a factor of two for structures that can accommodate $\frac{1}{2}$ inch of lateral deflection of the top of the pier foundation.

The spacing between adjacent piers should be equivalent to three pier diameters or more to avoid a reduction in lateral load resistance due to group effects for piers in a row perpendicular to the direction of lateral loading. For piers in a row parallel to the direction of lateral loading, the contribution of trailing piers to the lateral load resistance of the group should be neglected where the center to center spacing is less than eight pier diameters.

Drilled pier excavations should be cleaned of loose material prior to pouring concrete. Drilled pier excavations that encounter groundwater or cohesionless soil may be unstable and may need to be stabilized by temporary casing or use of drilling mud. Standing water should be removed from the pier excavation or the concrete should be delivered to the bottom of the excavation, below the water surface, by tremie pipe. Casing should be removed from the excavation as the concrete is placed. Concrete should be placed in the piers in a manner that reduces the potential for segregation of the components.

9.2.3 Slab-on-Grade Floors

Building slab-on-grade floors should be designed by the structural engineer based on the anticipated loading conditions. The slab should be reinforced with deformed steel bars with a nominal diameter of $\frac{3}{8}$ -inch or more. We recommend that masonry briquettes or plastic chairs be used to aid in the correct placement of slab reinforcement in the upper half of the slab. Refer to Section 9.6 for the recommended concrete cover over reinforcing steel. Joints consistent with ACI guidelines (ACI, 2016) may be constructed at periodic intervals to reduce the potential for random cracking of the slab. A vapor retarder is recommended in areas where moisture-sensitive floor coverings or conditioned environments are anticipated. See Section 9.7 for vapor retarding system recommendations. Where a vapor retarding system is not used, slabs should be constructed on 6 inches of compacted aggregate base conforming to Sections 9.3.6 and 9.3.8. Slab subgrade should be prepared in accordance with Section 9.3.7.

9.3 Earthwork

Earthwork should be performed in accordance with the requirements of applicable governing agencies and the recommendations presented below. The geotechnical consultant should observe earthwork operations. Evaluations performed by the geotechnical consultant during the course of operations may result in new recommendations, which could supersede the recommendations in this section.

9.3.1 Pre-Construction Conference

We recommend that a pre-construction conference be held to discuss the grading recommendations presented in the report. Representatives of the District, the architect, the engineer, Ninyo & Moore, and the contractor should be in attendance to discuss project schedule and earthwork requirements.

9.3.2 Site Preparation

Prior to performing earthwork operations, the site should be cleared of vegetation, surface soils containing roots or other organic matter, surface obstructions (e.g., pavements, aggregate base, curb/gutter, foundations, slabs-on-grade etc.), rubble and debris, and other deleterious materials from areas to be graded. Vegetation should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside of the proposed excavation and fill areas. Rubble and excavated materials that do not meet criteria for use as fill should be disposed of in an appropriate landfill. The stockpiles

of soil with organic matter present over portions of the site should be removed. Soil that can be processed to meet the criteria for general fill in Section 9.3.6 may be reused as general fill or chemically treated per the recommendations in Section 9.3.5 and used as select fill. Soils containing roots or other organic matter may be stockpiled for later use as landscaping fill, as authorized by the owner's representative. Stockpiled soil that cannot be used as landscaping fill or processed to meet criteria for general fill should be hauled to an appropriate landfill for disposal. Active utilities within the project limits, if any, should be re-routed or protected from damage by construction activities. Existing utilities or underground tanks/vaults to be abandoned should be excavated and removed. Excavations resulting from removal of buried utilities, tree stumps, or obstructions should be backfilled with compacted fill in accordance with the recommendations in the following sections.

9.3.3 Subgrade Observation

Prior to placement of fill or the erection of forms, the District should request an evaluation of the exposed subgrade by Ninyo & Moore. Materials that are considered unsuitable shall be excavated under the observation of Ninyo & Moore in accordance with the recommendations in this section, or the field recommendations of the geotechnical engineer. Unsuitable materials include, but may not be limited to dry, loose, soft, wet, expansive, organic, or compressible natural soils; and undocumented or otherwise deleterious fill materials. Unsuitable materials should be removed from below footings, slabs, and areas to receive fill to the depth of suitable material as evaluated by the geotechnical engineer in the field.

Laboratory testing indicates that the site soil has a medium to very high expansion characteristic. In addition, the upper foot or so of the ground surface has been disturbed by plowing and is considered unsuitable for the support of buildings and other significant foundations. Recommendations for remedial grading to mitigate concerns related to unsuitable subgrade materials and expansive soils are provided in the following section.

9.3.4 Remedial Grading

To mitigate the variable support characteristics related to the loose/disturbed condition of the upper fill observed during our exploration, and the potential for shrink or swell due to expansive soil, the building should be constructed over a pad of fill with low expansion characteristics. The pad of low expansion fill should extend to 3 feet below the nominal bottom of slab and one foot outside the building footprint. The pad of low expansion fill may be constructed by removing the existing subgrade soil at the building location and backfilling with imported select fill. After excavation, Ninyo & Moore should observe the condition of the

exposed subgrade to evaluate if additional excavation is needed. After this evaluation, the exposed subgrade should be scarified and moisture conditioned, as needed, to achieve a moisture content above the optimum. The conditioned subgrade should be compacted to 90 percent of the reference density as evaluated by ASTM D1557. The excavation may then be backfilled with imported select fill that conforms with the criteria in Section 9.3.6, and is placed and compacted in lifts per the recommendations in Section 9.3.8. A crushed rock capillary break layer or aggregate base layer under the slab may be considered as part of the layer with low expansion characteristics. As an alternative to importing select fill, site soil that conforms with the criteria for general fill may be chemically treated per the recommendations in Section 9.3.5 to create the layer with low expansion characteristics below the building. In general, the materials removed from the remedial excavations should be suitable for reuse as general fill, provided that the material is screened for rocks or lumps in excess of 3 inches in diameter, trash, debris, roots, vegetation, or deleterious materials.

To mitigate swell or heave of exterior flatwork or pavement due to expansive soil, the flatwork or pavement may be constructed over 12-inches of material with low expansion characteristics created by removing and replacing the site soil with select imported fill or by chemically treating the on-site soil per the recommendations in Section 9.3.5. The aggregate base or subbase section under the flatwork or pavement may be considered as part of the 12-inch layer with low expansion characteristics.

The extent of overexcavation and the zone of low-expansion material should be detailed on the construction plans to reduce the potential that these recommendations are overlooked during construction bidding.

9.3.5 Chemical Treatment

The on-site soil may be chemically treated with quicklime to reduce the expansion characteristic of the soil as an alternative to importing select fill. The quicklime should conform with ASTM Standard C977. Please note that chemical treatment of on-site soils may not be suitable for landscape areas or areas where permeable pavement is proposed.

On-site materials containing roots or organic matter exceeding 3 percent of the soil by dry weight are not suitable for chemical treatment and should be stripped from the area where the treatment is to be performed. The chemical treatment should be performed by an experienced contractor that specializes in the chemical treatment of soil. The chemical agent should be proportioned and spread with a mechanical spreader and mixed into the soil on a mixing table or in place to produce consistent distribution of the agent within the treated layer.

The depth of mixing should not exceed 18 inches per lift or the capacity of the mixer if less. Precautions to reduce the potential for dusting of quicklime or cement, such as scheduling or suspending operations to avoid windy weather, should be taken. Casting or tailgating of the chemical agent should not be permitted. The mixer should be equipped with a rotary cutting/mixing assembly, grade checker, and an automatic water distribution system. Mixing or spreading operations should not be performed during inclement weather or when the ambient temperature is less than 35 degrees Fahrenheit or during foggy or rainy weather. Adjacent passes of the mixer should overlap by 4 inches or more.

To reduce the expansion characteristic of the soil, quicklime should be mixed into the soil at a rate of 3 percent or more by dry weight of soil. Mixing and pulverizing should continue until the treated soil does not contain untreated soil clods larger than 1 inch and the quantity of untreated soil clods retained on the No. 4 sieve is less than 40 percent of the dry soil mass. Water should be added as-needed during the mixing process to achieve a moisture content above the optimum, as evaluated by ASTM D1557, for the lime-soil mixture. The lime-soil mixture should be re-mixed following a 16-hour mellowing period after the initial mixing. The lime-soil mixture should be compacted within 3 days after initial mixing to achieve 95 percent of the reference density as evaluated by ASTM D1557 on a wet density basis.

To improve the subgrade support characteristics, quicklime should be mixed into the soil as described above. Following the 16-hour mellowing period after the initial mixing, cement should be mixed into the soil at a rate of 3 percent or more by dry weight of soil. The moisture content of the soil should not exceed the optimum moisture content of the material, as evaluated by ASTM D1557, when the cement is spread and initially mixed. The subgrade should be mixed and aerated as-needed to reduce the moisture content. If additional water is needed to achieve the optimum moisture, the water should be added during a re-mixing operation after the cement has been initially mixed into the subgrade so as to reduce the potential for the formation of cement balls when water is applied. The cement-treated soil should be compacted within 2 hours of initial mixing to achieve 95 percent of the reference density as evaluated by ASTM D1557 on a wet density basis. Vehicular traffic and heavy construction equipment should not be allowed on the treated material for a 1-hour period after compaction. The cement-treated material should be maintained in a moist condition for a 7-day curing period by routinely sprinkling water, covering the treated material with moist straw, or placing fill over the treated subgrade. Treated subgrade for pavements should be proof-rolled with a loaded water truck to check for yielding conditions. Mitigation of yielding areas by pulverizing and re-mixing with additional stabilizing agent should be anticipated.

9.3.6 Material Recommendations

Materials used during earthwork, grading, and paving operations should comply with the requirements listed in Table 7. Materials should be evaluated by the geotechnical engineer for suitability prior to use. The contractor should notify the geotechnical consultant 72 hours prior to import of materials or use of on-site materials to permit time for sampling, testing, and evaluation of the proposed materials. On-site materials may need to be dried out before re-use as fill. The contractor should be responsible for the uniformity of import material brought to the site.

Table 7 – Geotechnical Recommendations for Materials

Material and Use	Source	Requirements ^{1,2,3}
Asphalt Concrete	Import	Type A; CSS ⁵ Section 39-2
Aggregate Base	Import	Class II; CSS ⁵ Section 39-2
Select (Low Expansion) Fill - Top 3 feet of building pad - Behind retaining walls ⁴ - Top foot below flatwork	Import	Close-graded with 35 percent or more passing No. 4 sieve and either: Expansion Index of 50 or less, Plasticity Index of 12 or less, or less than 10 percent, by dry weight, passing No. 200 sieve
	On-site borrow	As per general fill and treated with lime per Section 9.3.5
General Fill -For uses not otherwise specified	On-site borrow	Organic content 3 percent by dry weight or less
Permeable Aggregate - Capillary break gravel - Retaining wall backdrain	Import	Open-graded, clean, compactable crushed rock or angular gravel; nominal size 3/4" or less
Pipe/Conduit Bedding Material - Below conduit invert to 12 inches above conduit	Import	90 to 100 percent (by mass) should pass No. 4 sieve, and 5 percent or less should pass No. 200 sieve
Trench Backfill - Above pipe zone material and in top 3 feet of building pad or top foot below flatwork	Import or lime-treated site soil	As per select fill and excluding rock/lumps retained on 4-inch sieve or 2-inch sieve in top 12 inches
Trench Backfill - Above pipe zone material in other locations	Import or on-site borrow	As per general fill and excluding rock/lumps retained on 4-inch sieve or 2-inch sieve in top 12 inches
Controlled Low Strength Material (CLSM)	Import	CSS ⁵ Section 19-3.02G

Notes:

- 1 In general, fill should not consist of pea-gravel and should be free of rocks or lumps in excess of 6 inches in diameter, trash, debris, roots, vegetation or other deleterious material.
- 2 In general, import fill should be tested or documented to be non-corrosive and free from hazardous materials in concentrations above levels of concern.
- 3 Non-corrosive as defined by the Corrosion Guidelines (Caltrans, 2018).
- 4 Above a plane extending up and away from the heel of wall footing at 1:1 (horizontal to vertical) angle.
- 5 CSS is California Standard Specifications (Caltrans, 2015).

9.3.7 Subgrade Preparation

Subgrade below footings, slabs, pavement, walkways or fill, should be prepared as per the recommendations in Table 8. Recommendations for subgrade preparation for footings bearing on expansive subgrade are provided for retaining walls and deepened structural footings.

Table 8 – Subgrade Preparation Recommendations

Subgrade Location	Source
Below pavement	<ul style="list-style-type: none"> • Clear and grub as per Section 9.3.2. • Check for unsuitable materials as per Section 9.3.3. • Scarify top 8 inches then moisture condition and compact as per Section 9.3.8. • Proof roll compacted subgrade with loaded water truck under the observation of the geotechnical engineer. Mitigate yielding areas in accordance with the recommendations of the engineer. • Keep in moist but not saturated condition by sprinkling water.
Below building pads	<ul style="list-style-type: none"> • Clear and grub as per Section 9.3.2. • Perform remedial grading as per Section 9.3.4. • Keep in moist condition by sprinkling water
Utility trenches	<ul style="list-style-type: none"> • Check for unsuitable materials as per Section 9.3.3. • Remove or compact loose/soft material.
Below flatwork	<ul style="list-style-type: none"> • Clear and grub as per Section 9.3.2. • Perform remedial grading as per Section 9.3.4. • Keep in moist but not saturated condition by sprinkling water.
Below retaining walls	<ul style="list-style-type: none"> • Check for unsuitable materials as per Section 9.3.3. • Scarify and moisture condition exposed subgrade as-needed to achieve a moisture content approximately 2 points above the optimum as evaluated by ASTM D1557. Compact moisture-conditioned subgrade per Section 9.3.8. • Keep in moist condition by sprinkling water.
Below fill	<ul style="list-style-type: none"> • Clear and grub as per Section 9.3.2. • Check for unsuitable materials as per Section 9.3.3. • Scarify top 8 inches then moisture condition and compact as per Section 9.3.8. • Keep in moist but not saturated condition by sprinkling water.

9.3.8 Fill Placement and Compaction

Fill and backfill should be compacted in horizontal lifts in conformance with the recommendations presented in Table 9. The allowable uncompacted thickness of each lift of fill depends on the type of compaction equipment utilized, but generally should not exceed 8 inches in loose thickness. Heavy compaction equipment should not be used in the zone of influence behind retaining walls. The zone of influence is the region above a plane extending up and away from the heel of the wall at a slope of about 2:1 (horizontal to vertical).

Table 9 – Recommended Compaction Criteria

Fill Type	Location	Compacted Density ¹	Moisture Content ²
Asphalt Concrete	Pavement section	91 percent	Not Applicable
Aggregate Base	Flatwork and hardscape underlayment	95 percent	Near Optimum
Subgrade (not lime-treated)	Upper 12 inches below pavement for vehicles	95 percent	+ 2 percent
	In locations not already specified	90 percent	+ 2 percent
Bedding and Pipe Zone Fill	Material below invert to 12 inches above pipe	90 percent	Near Optimum
Trench Backfill	Below pavement (within 2 feet of finished grade)	95 percent	+ 2 percent
	In locations not already specified	90 percent	+ 2 percent
Lime- or cement-treated subgrade or fill	In locations not already specified	95 percent	+ 2 percent
Select or General Fill (not lime-treated)	Behind retaining walls	90 percent	+ 2 percent
	In locations not already specified	90 percent	+ 2 percent

Notes:

- 1 Expressed as percent relative compaction or ratio of field density to reference density (typically on a dry density basis for soil and aggregate and on a wet density basis for asphalt concrete and lime treated subgrade). The reference density of soil, lime-treated subgrade, and aggregate should be evaluated by ASTM D 1557. The reference density of asphalt concrete should be evaluated by ASTM D 2041.
- 2 Target moisture content at compaction relative to the optimum as evaluated by ASTM D 1557.

Compacted fill should be maintained in a moist (but not saturated) condition by the periodic sprinkling of water prior to placement of additional overlying fill. Fill that has been permitted to dry out and loosen or develop desiccation cracking, should be scarified, moisture conditioned, and recompacted as per the requirements above.

9.3.9 Temporary Excavations and Shoring

Trench excavations shall be stabilized in accordance with the Excavation Rules and Regulations (29 Code of Federal Regulations [CFR], Part 1926) stipulated by the Occupational Safety and Health Administration (OSHA). Stabilization shall consist of shoring sidewalls or laying slopes back.

Dewatering pits or sumps should be used to depress the groundwater level (if encountered) below the bottom of the excavation. Table 10 lists the OSHA material type classifications and corresponding allowable temporary slope layback inclinations for soil deposits that may be encountered on site. Alternatively, an internally-braced shoring system or trench shield conforming to the OSHA Excavation Rules and Regulations (29 CFR, Part 1926) may be used to stabilize excavation sidewalls during construction. The lateral earth pressures listed

in Table 10 may be used to design or select the internally-braced shoring system or trench shield. The recommendations listed in this table are based upon the limited subsurface data provided by our subsurface exploration and reflect the influence of the environmental conditions that existed at the time of our exploration. Excavation stability, material classifications, allowable slopes, and shoring pressures should be re-evaluated and revised, as-needed, during construction. Excavations, shoring systems and the surrounding areas should be evaluated daily by a competent person for indications of possible instability or collapse.

Table 10 – OSHA Material Classifications and Allowable Slopes

Formation	OSHA Classification	Allowable Temporary Slope ^{1,2,3}	Lateral Earth Pressure on Shoring ⁴ (psf)
Cohesive Fill & Alluvium (above groundwater)	Type B	1h:1v (45°)	45×D + 72
Granular Fill & Alluvium (above groundwater)	Type C	1½h:1v (34°)	80×D + 72

Notes:

- 1 Allowable slope for excavations less than 20 feet deep. Excavation sidewalls in cohesive soil may be benched to meet the allowable slope criteria (measured from the bottom edge of the excavation). The allowable bench height is 4 feet. The bench at the bottom of the excavation may protrude above the allowable slope criteria.
- 2 In layered soil, layers shall not be sloped steeper than the layer below.
- 3 Temporary excavations less than 4 feet deep may be made with vertical side slopes and remain unshored if judged to be stable by a competent person (29 CFR, Part 1926.650).
- 4 'D' is depth of excavation for excavations up to 20 feet deep. Includes a surface surcharge equivalent to two feet of soil.

The shoring system should be designed or selected by a suitably qualified individual or specialty subcontractor. The shoring parameters presented in this report are preliminary design criteria, and the designer should evaluate the adequacy of these parameters and make appropriate modifications for their design. We recommend that the contractor take appropriate measures to protect workers. OSHA requirements pertaining to worker safety should be observed.

Excavations made in close proximity to existing structures may undermine the foundation of those structures and/or cause soil movement related distress to the existing structures. Stabilization techniques for excavations in close proximity to existing structures will need to account for the additional loads imposed on the shoring system and appropriate setback distances for temporary slopes. The geotechnical engineer should be consulted for additional recommendations if the proposed excavations cross below a plane extending down and away from the foundation bearing surfaces of the adjacent structure at an angle of 2:1 (horizontal to vertical).

9.3.10 Construction Dewatering

Groundwater was not encountered in our exploratory borings. However, significant fluctuations in the groundwater level may occur as a result of variations in seasonal precipitation and other factors. Water intrusion into the excavations may occur as a result of groundwater intrusion or surface runoff. The contractor should be prepared to take appropriate dewatering measures in the event that water intrudes into the excavations. Considerations for construction dewatering should include anticipated drawdown, volume of pumping, potential for settlement, and groundwater discharge. Disposal of groundwater should be performed in accordance with the guidelines of the Regional Water Quality Control Board.

9.3.11 Utility Trenches

Trenches constructed for the installation of underground utilities should be stabilized in accordance with our recommendations in Section 9.3.9. Utility trenches should be backfilled with materials that conform to our recommendations in Section 9.3.6. Trench backfill, bedding, and pipe zone fill should be compacted in accordance with Section 9.3.8 of this report. Bedding and pipe zone fill should be shoveled under pipe haunches and compacted by manual or mechanical tampers. Trench backfill should be compacted by mechanical means. Densification of trench backfill by flooding or jetting should not be permitted.

Trenches should not be excavated adjacent to footings. If trenches are to be excavated near a footing, the bottom of the trench should be located above a 2:1 (horizontal to vertical) plane projected downward from the bottom of the footing. Utility lines that cross beneath footings should be encased in concrete or CLSM below the footing for a distance equivalent to the depth of the excavation.

9.3.12 Rainy Weather Considerations

Earthwork and foundation construction should be performed during the period between approximately April 15 and October 15 to avoid the rainy season. In the event that grading is performed during the rainy season, the plans for the project should be supplemented to include a stormwater management plan prepared in accordance with the requirements of the relevant agency having jurisdiction. The plan should include details of measures to protect the subject property and adjoining off-site properties from damage by erosion, flooding or the deposition of mud, debris, or construction-related pollutants, which may originate from the site or result from the grading operation. The protective measures should be installed by the commencement of grading, or prior to the start of the rainy season. The protective measures

should be maintained in good working order unless the project drainage system is installed by that date and approval has been granted by the building official to remove the temporary devices.

In addition, construction activities performed during rainy weather may impact the stability of excavation subgrade and exposed ground. Temporary swales should be constructed to divert surface runoff away from excavations and slopes. Steep temporary slopes should be covered with plastic sheeting during significant rains. The geotechnical consultant should be consulted for recommendations to stabilize the site as-needed.

Subgrade exposed to water may soften and be subject to pumping under equipment loads. The contractor should be prepared to stabilize exposed subgrade and the bottom of the excavations. In general, unstable subgrade may be mitigated by scarification and aeration of the soil to achieve a moisture content near the optimum, removal of accumulated water or dewatering to depress groundwater levels below the bottom of the excavation, overexcavating to a suitable depth and replacing the wet material with suitable fill, compacting a layer of crushed rock fill into the subgrade, or using geogrid to stabilize additional fill. Specific recommendations for excavation stabilization will be influenced by the nature of the excavation and the conditions encountered during construction.

9.4 Retaining Walls

Walls backfilled with imported select fill or lime-treated on-site soil and retaining up to 10 feet of soil above the wall footing may be designed for active or at-rest equivalent fluid earth pressures of 83 or 93 psf per foot depth, respectively, for undrained conditions with level backfill. Walls with drained backfill conditions may be designed for active or at-rest equivalent fluid earth pressures of 40 or 60 psf per foot depth, respectively, with level backfill. Walls that yield or deflect may be designed for active earth pressures. Wall deflection equivalent to about 1 percent of wall height may be needed to reduce at-rest earth pressures to active earth pressures. Vaults or other below grade walls that are restrained by framing, floor diaphragms, or abutting walls should be designed to resist at-rest earth pressures. For rising backfill conditions, the active or at-rest equivalent fluid earth pressures may be increased by 1 psf per foot depth per degree of inclination. An additional equivalent fluid pressure of 33 psf per foot depth may be used to evaluate seismic earth pressure on retaining walls, as appropriate, for consideration with active earth pressures.

Walls retaining level ground should be designed to resist construction or live load surcharges on the backfill. The lateral earth pressure due to a backfill surcharge of 240 psf should be a uniform horizontal surcharge of 80 psf for yielding conditions and 120 psf for at-rest conditions. An

additional backfill surcharge and lateral earth pressure for adjacent footings should be considered, as applicable, where the adjacent footings bear above an imaginary plane that rises up and away from the bottom edge of the wall at a 2:1 (horizontal to vertical) gradient.

Hydrostatic pressures may be neglected, provided that suitable drainage of the retained soil is provided. The retained soil should be drained by weep holes or a subdrain at the base of the wall stem consisting of $\frac{3}{4}$ -inch crushed rock wrapped in filter fabric (Mirafi 140N, or equivalent). The subdrain should be capped by a pavement or 12 inches of native soil and drained by a perforated pipe (Schedule 40 polyvinyl chloride pipe, or similar). The pipe should be sloped at 1 percent or more to discharge at an appropriate outlet away from the wall. Alternatively, geocomposite drain panels (Miradrain 6000XL, or similar) placed against the back of the wall may be used to supplement a smaller subdrain located near the base of the wall. Measures to reduce the rate of moisture or vapor intrusion through the wall may be advisable for walls where the discoloration resulting from moisture intrusion would be undesirable. Such measures might include use of concrete with a low water-to-cementitious-materials ratio, and/or the placement of an asphalt emulsion or 10-mil thick plastic membrane to the back surface of the wall.

Lateral forces may be resisted by friction at the base of the wall footing for gravity and semi-gravity walls, and passive earth pressure acting on the embedded wall, wall footing, or wall key, if present, for semi-gravity and cantilever walls. Semi-gravity and cantilever walls on near level ground may be designed for a passive equivalent fluid lateral earth pressure of 300 psf per foot depth presuming a lateral deflection equivalent to 1 percent of the wall embedment depth to mobilize the passive condition. The passive earth pressure may be proportionally reduced for lower levels of lateral deflection as desired. The passive earth pressure for walls on ground sloping more than 5 percent should be reduced by 5 psf per foot depth per degree of inclination. Passive earth pressure should be neglected to a depth of 1 foot below the ground surface when evaluating lateral load resistance where the ground surface is not covered by pavement or flatwork. Gravity and semi-gravity walls may be designed for a coefficient of friction of 0.35 to resist lateral loads and a net allowable bearing capacity of 1,300 psf for a 12-inch footing width and 12 inches of embedment below the adjacent grade plus 200 psf per additional foot of width and 600 psf per additional foot of embedment up to 4,000 psf. The allowable bearing capacity may be increased by one-third for seismic load combinations. The coefficient of friction may be increased to 0.50 where the footing is constructed over 6 inches of aggregate base compacted to 95 percent of the reference density as evaluated by ASTM D1557.

Footings should not be sloped more than 1 unit vertical to 10 units horizontal. Wall footings may be stepped provided that the bearing grade differential between adjacent steps does not exceed 18 inches and the slope of a series of such steps does not exceed 1 unit vertical to 2 units horizontal. Walls should be designed to withstand a total static settlement of 1 inch with a differential of ½ inch over a 20-foot span.

9.5 Pavements and Flatwork

Recommendations for pavement and exterior flatwork are presented in the following sections. Based on R-value testing of surficial soils at the campus, a design R-value of 5 was selected due to the potential for variability in subgrade support characteristics. Subgrade support characteristics can be further evaluated during rough grading. An increase in the design R-value may be appropriate based on R-value testing and the observed condition of the exposed subgrade. Recommendations for preparation of subgrade are presented in Section 9.3.7. Pavement sections were evaluated for a range of traffic indexes or loading conditions. The designer may interpolate between the values provided once a traffic index or loading condition has been selected.

9.5.1 Asphalt Pavement

Ninyo & Moore conducted an analysis to evaluate appropriate asphalt pavement structural sections following the methodology presented in the Highway Design Manual (Caltrans, 2016). Alternative sections were evaluated. The pavement sections were designed for a 20-year service life presuming that periodic maintenance, including crack sealing and resurfacing will be performed during the service life of the pavement. Premature deterioration may occur without periodic maintenance. Our recommendations for the pavement sections are presented in Table 11.

Table 11 – Asphalt Concrete Pavement Structural Sections

Design R-Value	Traffic Index	Alternative 1	Alternative 2	Alternative 3
5	5	3 inches AC 5 inches AB 7 inches ASB	3 inches AC 8 inches AB SEG	3 inches AC 6 inches AB 12 inches TS
5	6	3½ inches AC 13 inches AB	3½ inches AC 10 inches AB SEG	3½ inches AC 8 inches AB 12 inches TS
5	8	5 inches AC 18 inches AB	5 inches AC 14 inches AB SEG	5 inches AC 10 inches AB 12 inches TS
5	10	6½ inches AC 23 inches AB	6½ inches AC 18 inches AB SEG	6½ inches AC 13 inches AB 12 inches TS

¹ AC is Type A, Dense-Graded Hot Mix Asphalt complying with Caltrans Standard Specification 39-2 (2015).

² AB is Class II Aggregate Base complying with Caltrans Standard Specification 26-1.02 (2015).

³ ASB is Class II Aggregate Subbase complying with Caltrans Standard Specification 25-1.02 (2015).

⁴ SEG is subgrade enhancement geotextile such as Mirafi 600X.

⁵ TS is chemically treated subgrade consistent with the recommendations in Section 9.3.5.

Paving operations and base preparation should be observed and tested by Ninyo & Moore. Subgrade enhancement geotextiles, where utilized, should be rolled out flat and tight, without folds or wrinkles, over prepared subgrade in the direction of travel. The geotextile should be pinned to the subgrade with nails and washers or u-shaped sod staples. Adjacent rolls should overlap 12 inches or more. Abutting rolls should overlap in the direction of fill placement to reduce the potential for peeling of the geotextile during fill placement. Aggregate base fill should be pushed over the geotextile into position and compacted. To reduce the potential for displacement of the geotextile or deterioration of the subgrade, construction equipment should not operate on the geotextile with 6 inches of aggregate base cover.

Aggregate base for pavement should be placed in lifts of no more than 8 inches in loose thickness and compacted per Section 9.3.8. Asphalt concrete should be placed and compacted per Section 9.3.8. Pavements should be sloped so that runoff is diverted to an appropriate collector (concrete gutter, swale, or area drain) to reduce the potential for ponding of water on the pavement. Concentration of runoff over asphalt pavement should be discouraged. Cracks that form in the asphalt concrete surface should be periodically sealed to reduce moisture intrusion into the aggregate base section. Deep curbs that extend 6 inches below the aggregate base section may be used to reduce the potential moisture intrusion into the aggregate base section adjacent to landscaped areas or the bottom of slopes. Subdrains may be considered as a supplement or alternative means of the mitigating moisture in the aggregate base section. Underlayment with SEG below the aggregate base section should

be considered to mitigate cracking near the edge of pavement due to differential shrink/swell behavior of expansive subgrade soil where lateral confinement from adjacent curbs or pavements is not provided. Root barriers adjacent to trees may be considered to reduce the potential for pavement heave from root growth.

9.5.2 Exterior Flatwork

Concrete walkways and other exterior flatwork not subject to vehicular loading should be 4 inches thick (or more) over 6 inches of aggregate base. Concrete thickness should be increased to 6 inches at driveways for vehicular traffic up to periodic garbage trucks and emergency vehicles. The aggregate base should conform to and be compacted in accordance with our recommendations in Sections 9.3.6 and 9.3.8, respectively. Flatwork and driveway subgrade should be prepared in accordance with the recommendations in Section 9.3.7.

Appropriate jointing of concrete flatwork can encourage cracks to form at joints, reducing the potential for crack development between joints. Joints should be laid out in a square pattern at consistent intervals. Contraction and construction should be detailed and constructed in accordance with the guidelines of ACI Committee 302 (ACI, 2016). The lateral spacing between contraction joints should be 8 feet or less for a 4-inch thick slab and 12 feet or less for a 6-inch thick slab. Contraction joints formed by premolded inserts, grooving plastic concrete, or saw-cutting at initial hardening, should extend to a depth equivalent to 25 percent of the slab thickness and 1 inch or more for thin slabs.

Flatwork may be reinforced with distributed steel to reduce the potential for differential slab movement where cracking occurs. The distributed reinforcing steel should be terminated about 6 inches from contraction joints and should consist of No. 3 deformed bars at 18 inches on center, both ways. Slabs reinforced with distributed steel should be 6 inches thick (or more). To reduce the potential for differential slab movement across joints, the distributed steel may be extended through the joints. This improvement will be balanced by a reduction in the functionality of the contraction joint to encourage crack formation at joints. Masonry briquettes or plastic chairs should be used to maintain the position of the reinforcement in the upper half of the slab with 1½ inches of cover over the steel. Root barriers adjacent to trees may be considered to reduce the potential for pavement heave from root growth.

9.6 Concrete

Laboratory testing indicated that the site soil may be considered a corrosive environment to structures per the Caltrans Corrosion Guidelines (2018) with a sulfate exposure classification of

S2 corresponding to a severe potential for sulfate attack on concrete. For this level of sulfate exposure, Type II/V or Type V cement should be used for concrete structures in contact with soil. In addition, we recommend concrete exposed to soil should have a water-to-cement ratio of no more than 0.45 and a 28-day compressive strength not less than 4,500 pounds per square inch. A 3-inch thick, or thicker, concrete cover should be maintained over reinforcing steel where concrete is cast-in-place against soil. Concrete cover over reinforcing steel for other exposure conditions should conform to ACI guidelines (ACI, 2016). A corrosion engineer should be consulted to further assess the potential for corrosion, review these mitigation measures, and provide recommendations for supplementary measures as-needed.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that the concrete for slabs and flatwork should not contain large quantities of water or accelerating admixtures containing calcium chloride. Higher compressive strengths may be achieved by using larger aggregates in lieu of increasing the cement content and corresponding water demand. Additional workability, if desired, may be obtained by including water-reducing or air-entraining admixtures. Concrete should be placed in accordance with ACI Manual of Concrete Practice (MCP) and project specifications. Particular attention should be given to curing techniques and curing duration. Slabs that do not receive adequate curing have a more pronounced tendency to curl upwards at edges and corners, and to develop random shrinkage cracks and other defects.

9.7 Moisture Vapor Retarder

The migration of moisture through slabs underlying enclosed spaces or overlain by moisture sensitive floor coverings should be discouraged by providing a moisture vapor retarding system between the subgrade soil and the bottom of slabs. We recommend that the moisture vapor retarding system consist of a 4-inch-thick capillary break, overlain by a 15-mil-thick plastic membrane. Sand should not be placed over the vapor retarder. The capillary break should be constructed of clean, compacted, open-graded crushed rock or angular gravel of ¾-inch nominal size. The crushed rock or angular gravel should be compacted with a vibratory plate compactor or roller to reduce the potential for damage to the vapor retarder by rock puncture during placement of reinforcement and concrete. The plastic membrane should conform to the requirements in the latest version of ASTM Standard E 1745 for a Class A membrane. The bottom of the moisture barrier system should be higher in elevation than the exterior grade, if possible. Positive drainage should be established and maintained adjacent to foundations and flatwork.

Where the exterior grade is at a higher elevation than the moisture vapor retarding system (including the capillary break layer), consideration should be given to constructing a subdrain around the foundation perimeter. The subdrain should consist of $\frac{3}{4}$ -inch crushed rock wrapped in filter fabric (Mirafi 140N, or equivalent). The subdrain should be capped by a pavement or 12 inches of native soil and drained by a perforated pipe (Schedule 40 polyvinyl chloride pipe, or similar). The pipe should be sloped at 1 percent or more to discharge at an appropriate outlet away from the foundation. The pipe should be located below the bottom elevation of the moisture vapor retarding system but above a plane extending down and away from the bottom edge of the foundation at a 2:1 (horizontal to vertical) gradient.

9.8 Drainage and Site Maintenance

Surface drainage on the site should generally be provided so that water is diverted away from structures and is not permitted to pond. Positive drainage should be established adjacent to structures to divert surface water to an appropriate collector (graded swale, v-ditch, or area drain) with a suitable outlet. Drainage gradients should be 2 percent or more a distance of 5 feet or more from the structure for impervious surfaces and 5 percent or more a distance of 10 feet or more from the structure for pervious surfaces. Slope, pad, and roof drainage (from adjacent structures) should be collected and diverted to suitable discharge areas away from structures or other slopes by non-erodible devices (e.g., gutters, downspouts, concrete swales, etc.). Graded swales, v-ditches, or curb and gutter should be provided at the site perimeter to restrict flow of surface water onto and off of the site. Slopes should be vegetated or otherwise armored to reduce potential for erosion of soil. Drainage structures should be periodically cleaned out and repaired, as-needed, to maintain appropriate site drainage patterns.

Landscaping adjacent to foundations should include vegetation with low-water demands and irrigation should be limited to that which is needed to sustain the plants. Trees should be restricted from the areas adjacent to foundations a distance equivalent to the canopy radius of the mature tree. Stormwater management facilities that percolate water into the subgrade should not be located within a distance of 20 feet from structure foundations.

Care should be taken by the contractor during grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices on or adjacent to the project area. Drainage patterns established at the time of grading should be maintained for the life of the project. Future alteration of the established drainage patterns may impact the constructed improvements.

9.9 Review of Construction Plans

The recommendations provided in this report are based on preliminary design information for the proposed construction. We recommend that a copy of the plans be provided to Ninyo & Moore for review before bidding to check the interpretation of our recommendations and that the designed improvements are consistent with our assumptions. It should be noted that, upon review of these documents, some recommendations presented in this report might be revised or modified to meet the project requirements.

9.10 Construction Observation and Testing

The recommendations provided in this report are based on subsurface conditions encountered in discrete borings. During construction, the geotechnical engineer should be retained to perform construction observation and testing as follows to check that the work performed conforms with the geotechnical recommendations and the subsurface conditions exposed in the construction excavations are consistent with the assumed conditions from the exploratory borings:

- Observe removal of unsuitable materials, chemical treatment, and remedial grading.
- Observe preparation and compaction of subgrade.
- Check and test imported materials prior to use as fill.
- Observe placement and compaction of fill.
- Perform field density tests to evaluate fill and subgrade compaction.
- Observe pier drilling and placement of concrete.
- Observe the condition of the water vapor retarding system before concrete placement.
- Observe foundation excavations for bearing materials and cleaning prior to placement of reinforcing steel and concrete.

The recommendations provided in this report assume that Ninyo & Moore will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the architect and the owner (with a copy to Ninyo & Moore) indicating that they fully understand Ninyo & Moore's recommendations, and that they are in full agreement with the recommendations contained in this report.

10 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

11 REFERENCES

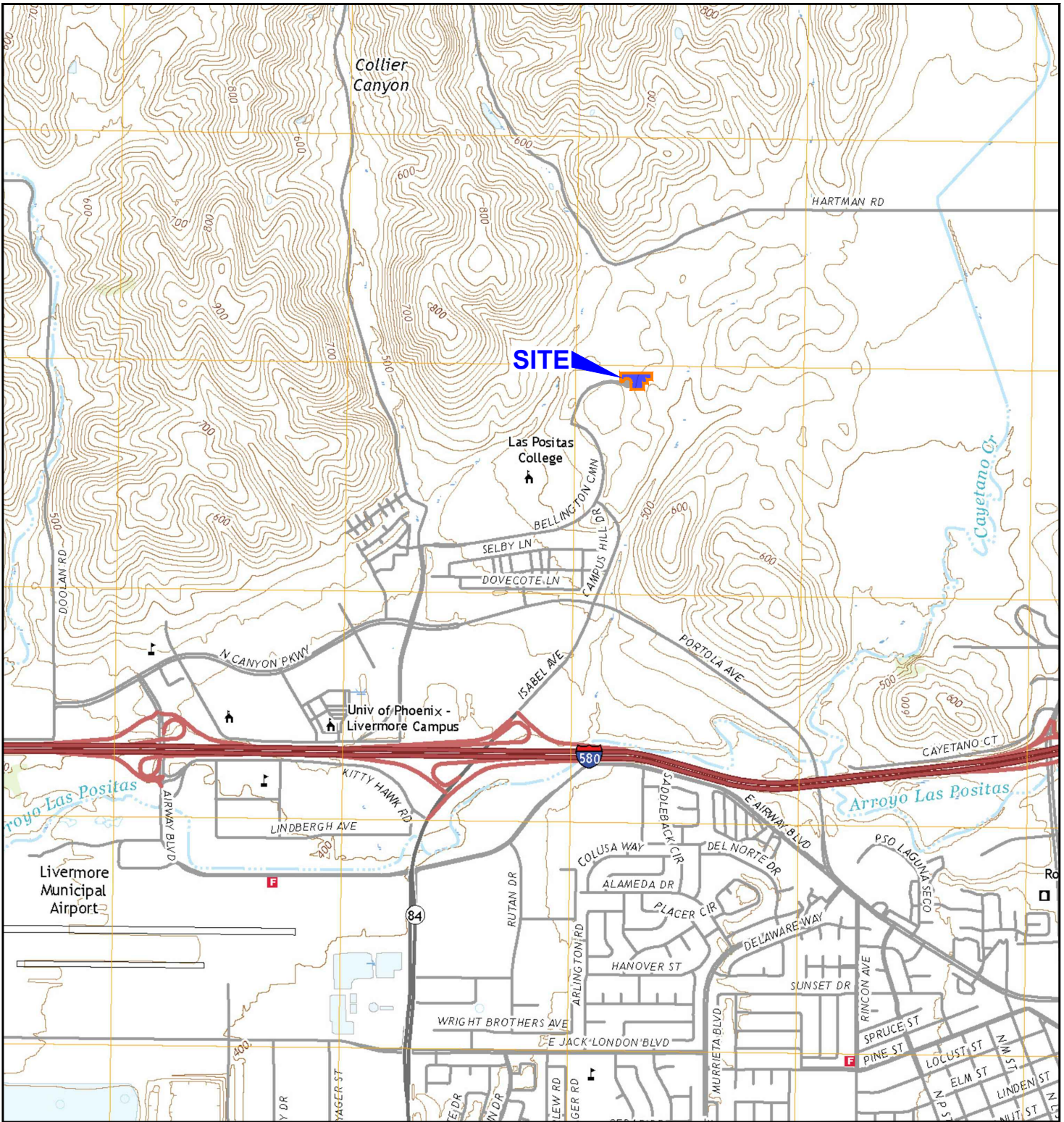
- Abrahamson, N.A., Silva, W.J. and Kamai (ASK14), R., 2014, Summary of the ASK14 Ground Motion Relation for Active Crustal Regions, Earthquake Spectra: Vol. 30, No. 3, pp. 1025-1055, dated August.
- American Concrete Institute, 2016, ACI Manual of Concrete Practice.
- American Society of Civil Engineer (ASCE), 2016, Minimum Design Loads for Buildings and Other Structures, Standard 7-16.
- American Society for Testing and Materials (ASTM), 2019, Annual Book of ASTM Standards, West Conshohocken, Pennsylvania.
- ATI Architects and Engineers, 2019, Agriculture Science – Horticulture Facility, Chabot-Las Positas Community College District – Las Positas College, 3000 Campus Hill Drive, Livermore, California, Plan Set dated December 19.
- ATI Architects and Engineers, 2020, Horticulture Facility, Conceptual Site Plan – Revised Location, Las Positas College, single sheet, dated January 16.
- Barlock, V.E., 1988, Geologic Map of the Livermore Gravels, Alameda County, California: U.S. Geological Survey Open-File Report 88-516, Scale 1:24,000.
- Bohley Consulting, 2008, Grading Plan, Las Positas College, Athletic Complex Phase III, 3033 Collier Canyon Road, Livermore, California, Project No. 0724100, Drawing C2.0, dated April 23.
- Boore, D.M., Stewart, J.P., Seyhan, E., and Atkinson, G.M. (BSSA14), 2014, NGA-West2 Equations for Predicting PGA, PGV, and 5% Damped PSA for Shallow Crustal Earthquakes, Earthquake Spectra, Vol. 30, No. 3, pp. 1057-1085, dated August.
- Bray, J.D., and Sancio, R.B., 2006, Assessment of the Liquefaction Susceptibility of Fine-Grained Soils, Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers (ASCE), Vol. 132, No. 9, pp. 1165-1177.
- California Building Standards Commission (CBSC), 2019, California Building Code: California Code of Regulations, Title 24, Part 2, Volumes 1 and 2, based on the 2018 International Building Code.
- California Department of Toxic Substances and Control (DTSC), 2004, Interim Guidelines, Naturally Occurring Asbestos (NOA) at School Sites: State of California Department of Toxic Substances and Control, dated September 24, 2004.
- California Department of Transportation (Caltrans), 2015, Standard Specifications: dated May.
- California Department of Transportation (Caltrans), 2016, Highway Design Manual, <http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm>, dated December 16.
- California Department of Transportation (Caltrans), 2018, Corrosion Guidelines, Version 3.0, Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Branch: dated March.
- California Department of Transportation (Caltrans), 2019, Caltrans Fault Database for ARS Online, Version 2.3.09, http://dap3.dot.ca.gov/ARS_Online.
- California Division of Mines and Geology (CDMG), 1980, California Geology: The Livermore Earthquake of January 1980, Contra Costa and Alameda Counties, California, April 1980, Volume 33, No. 4.

- California Geological Survey (CGS), 1982, Official Map of Earthquake Fault Zones for the Livermore 7.5-minute Quadrangle, Alameda County, California: dated January 1: scale 1:24,000.
- California Geological Survey (CGS), 2000, Epicenters of and Areas Damaged by M \geq 5 California Earthquakes, Map Sheet 49, dated December 14.
- California Geological Survey (CGS), 2008, Official Map of Seismic Hazard Zones for the Livermore 7.5 Minute Quadrangle, Alameda County, California, Scale: 1:24,000, dated August 27.
- California Geological Survey (CGS), 2008a, Seismic Hazard Zone Report for the Livermore 7.5 Minute Quadrangle, Alameda County, California, Seismic Hazard Zone Report 114.
- California Geological Survey (CGS), 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: California Geologic Survey Special Publication 42.
- Campbell, K.W., and Bozorgnia, Y. (CB14), 2014, NGA-West2 Ground Motion Model for the Average Horizontal Components of PGA, PGV, and 5% Damped Linear Acceleration Response Spectra, Earthquake Spectra, Vol. 30, No. 3, pp. 1087-1115, dated August.
- Chiou, B. S.-J., and Youngs, R.R. (CY14), 2014, Update of the Chiou and Youngs NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra, Earthquake Spectra, August 2014, Vol. 30, No. 3, dated August.
- Churchill, R.K., and Hill, R.L., 2000, A General Location Guide for Ultramafic Rocks in California – Areas More Likely to Contain Naturally Occurring Asbestos: California Division of Mines and Geology, Open-File Report 2000-19.
- Crane, R.C., 1995, Geology of Mount Diablo Region and East Bay Hills; in Recent Geological Studies of the San Francisco Bay Area, SEPM, Pacific Section, Vol. 76, p 87-114: scale 1:24,000.
- Dibblee, T.W., and Minch, J.A., 2006, Geologic Map of the Livermore Quadrangle, Contra Costa and Alameda Counties, California: Dibblee Geology Center Map DF-196, Scale 1:24,000.
- Federal Emergency Management Agency (FEMA), 2009, Flood Insurance Rate Map, Alameda County, California and Incorporated Areas, Panel 06001C0333G, dated August 3.
- Field, E.H., Jordan, T.H., and Cornell, C.A., 2003, OpenSHA: A Developing Community-Modeling Environment for Seismic Hazard Analysis: Seismological Research Letters, Vol. 74, No. 4, pp. 406-419.
- Google, 2019, Google Earth Pro 7.3.2.5776, <http://earth.google.com/>
- Graymer, R.W., Jones, D.L., and Brabb, E.E., 1996, Preliminary Geologic Map Emphasizing Bedrock Formations in Alameda County, California, USGS, OFR 96-252, scale 1:75:000.
- Herd, D.G., 1977, Geologic Map of the Las Positas, Greenville, and Verona Faults, Eastern Alameda County, California, USGS OFR 77-689: Scale 1:24,000.
- Jennings, C.W. and Bryant, W.A., 2010, Fault Activity Map of California and Adjacent Areas: California Geological Survey, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.
- Knudsen, K.L., Sowers, J.M., Witter, R.C., Wentworth, C.M., Helley, E.J., Nicholson, R.S., Wright, H.M., and Brown, K.H., 2000, Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: a digital database: U.S. Geological Survey, Open-File Report OF-2000-444, Scale 1:275,000.

- Majmunder, H., 1991, Landslide Hazards in the Livermore Valley and Vicinity, Alameda and Contra Costa Counties, California: CDMG Landslide Hazard Identification Map 21 DMG OFR 91-2: scale 1:24,000.
- Nilsen, T.H., 1975, Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Livermore 7.5 minute Quadrangle, Alameda County, California: U.S. Geological Survey Open-File Map 75-277-76, Scale 1:24,000.
- Ninyo & Moore, 2007, Potential Fault Evaluation Study, Las Positas Community College, Livermore, California, Project No. 401294005, dated August 24.
- Ninyo & Moore, 2008, Geologic Hazards Assessment and Geotechnical Evaluation, Phase III Athletic Complex, Las Positas College, Livermore, California, Project No. 401425001, dated September 10.
- Ninyo & Moore, 2010, Summary of Earthwork Observation and Relative Compaction Testing, Maintenance and Operations Facility, Las Positas College, Livermore, California, Project No. 401294012, dated February 1.
- Ninyo & Moore, 2011, Summary of Earthwork Observation and Relative Compaction Testing, Athletic Complex, Phase III, Las Positas College, Livermore, California, DSA Plan File No. 1-C2, DSA Application No. 01-110118, Project No. 401294020, dated April 21.
- Sandis, 2019, Topographic Survey, Las Positas College, Livermore, California, Drawing No. 618184, dated September 10.
- Scheimer, J.F., Taylor, S.R., and Sharp, M., 1982, Seismicity of the Livermore Valley Region, 1969-1981; in Hart, E.W., Hirschfeld, S.E., Schulz, S.S., 1982, Proceedings: Conference on Earthquake Hazards in the Eastern San Francisco Bay Area: CDMG Special Publication 62.
- Seyhan, E., 2014, Weighted Average 2014 NGA West-2 GMPE, Pacific Earthquake Engineering Research Center.
- State of California, 2009, Tsunami Inundation Map for Emergency Planning, San Francisco Bay Area; produced by California Emergency Management Agency, California Geological Survey, and University of Southern California – Tsunami Research Center, Scale 1:150,000, dated December 9.
- Structural Engineers Association of California's and California's Office of Statewide Health Planning and Development (SEAOC/OSHPD), 2020, Seismic Design Maps, <https://seismicmaps.org>.
- United States Geological Survey (USGS), 2018, Livermore 7.5 Minute Quadrangle Topographic Map, Alameda County, California, Scale 1:24,000.
- United States Geological Survey (USGS), 2019, U.S. Quaternary Faults, World Wide Web, <https://usgs.maps.arcgis.com/apps/webappviewer/index.html>.
- Working Group on California Earthquake Probabilities, 2013, Uniform California earthquake rupture forecast, version 3 (UCERF3)—The time-independent model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, <http://pubs.usgs.gov/of/2013/1165/>.



FIGURES



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NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE | REFERENCE: USGS, 2018

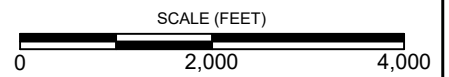
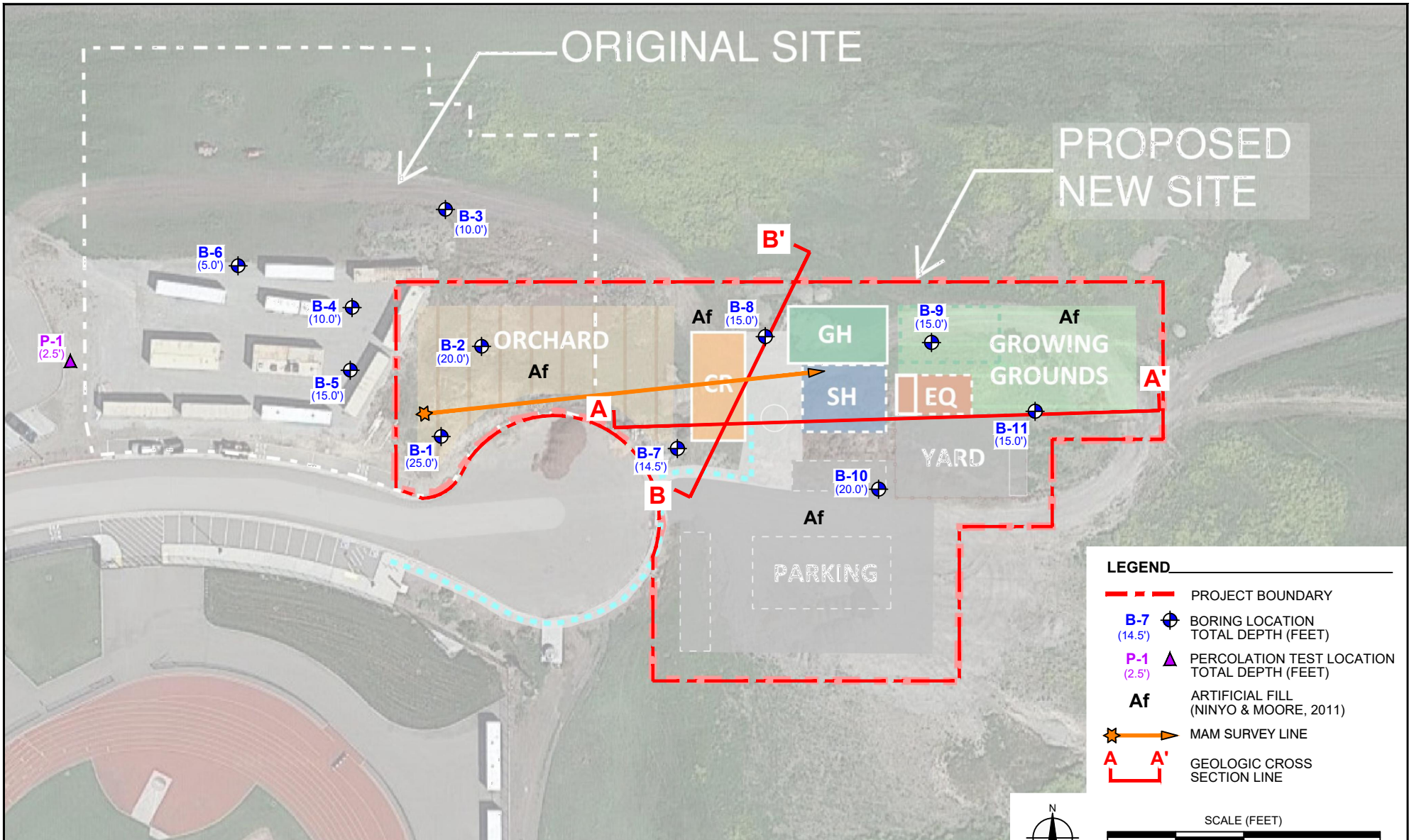


FIGURE 1

SITE LOCATION

LAS POSITAS COLLEGE - AGRICULTURAL SCIENCE: HORTICULTURE FACILITY
 3000 CAMPUS HILL DRIVE, LIVERMORE, CALIFORNIA

401294035 | 03/20



NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE | REFERENCE: LPC, 2020

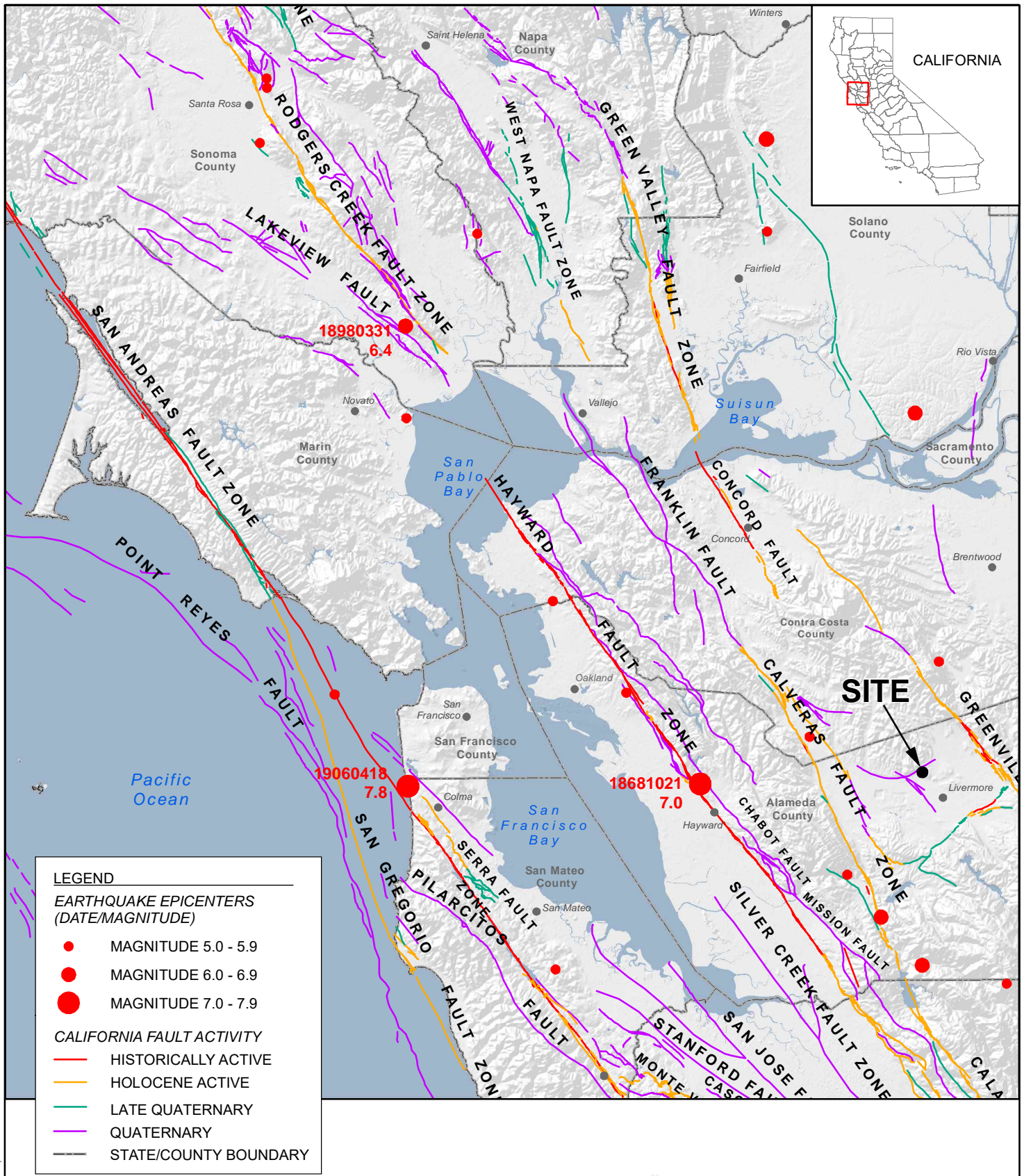
LEGEND

- - - PROJECT BOUNDARY
- B-7 BORING LOCATION
TOTAL DEPTH (FEET)
- P-1 PERCOLATION TEST LOCATION
TOTAL DEPTH (FEET)
- Af** ARTIFICIAL FILL
(NINYO & MOORE, 2011)
- MAM SURVEY LINE
- A A' GEOLIGIC CROSS SECTION LINE

SCALE (FEET)
0 80 160

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FIGURE 2



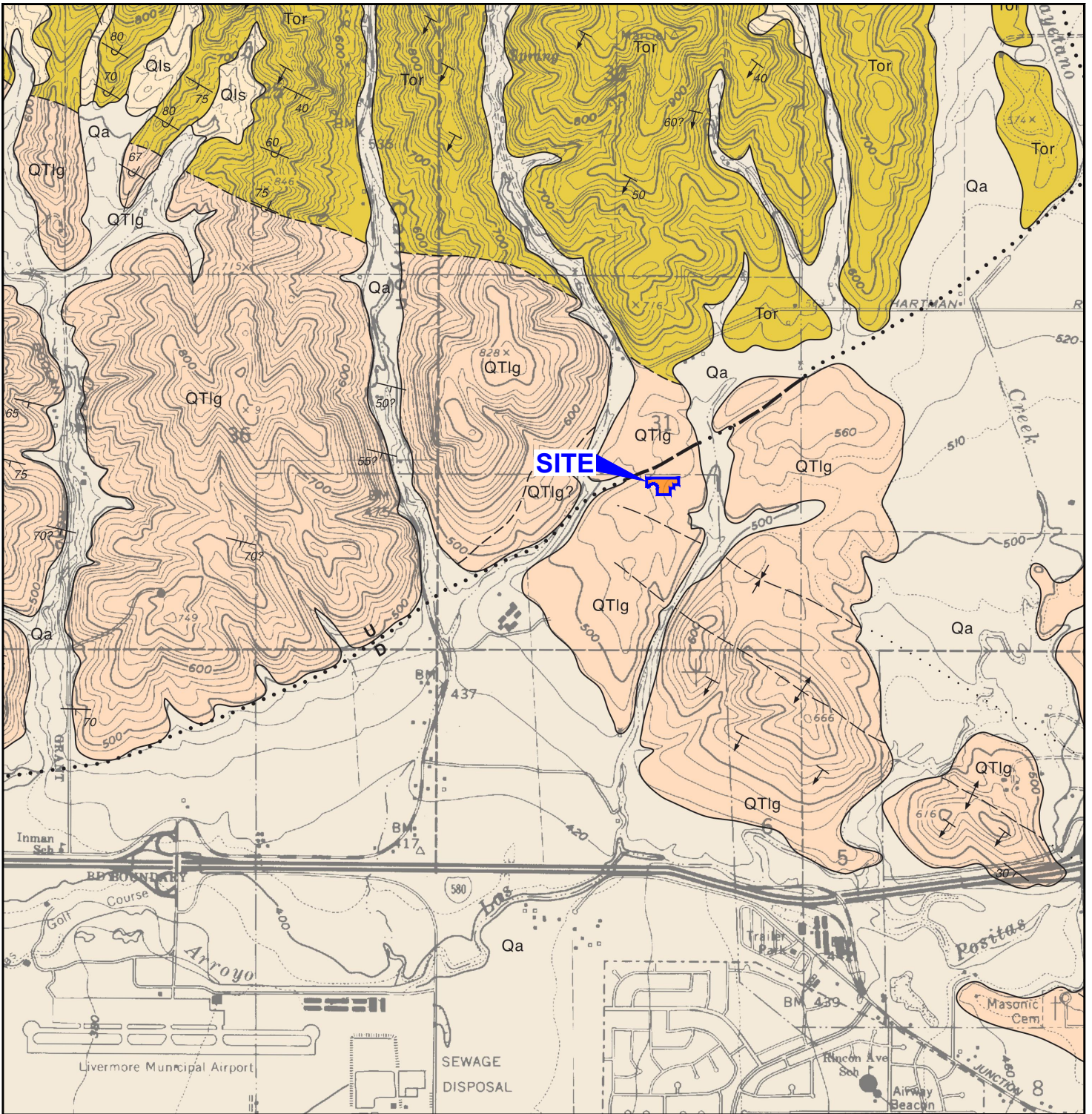
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FIGURE 3

FAULT LOCATIONS AND EARTHQUAKE EPICENTERS

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 3000 CAMPUS HILL DRIVE, LIVERMORE, CALIFORNIA

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LEGEND

Qa ALLUVIAL GRAVEL, SAND, & CLAY OF VALLEY AREAS (HOLOCENE)	QTlg LIVERMORE GRAVELS (PLEISTOCENE)	THRUST FAULT	GEOLOGIC CONTACT
Qls LANDSLIDE RUBBLE (HOLOCENE)	Tor ORINDA FORMATION: PEBBLE CONGLOMERATE, SANDSTONE, & CLAYSTONE (PLIOCENE)	FAULT	STRIKE AND DIP OF BEDDING

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE | REFERENCE: DIBBLEE, 2006

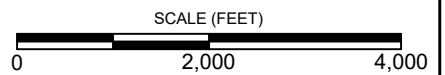
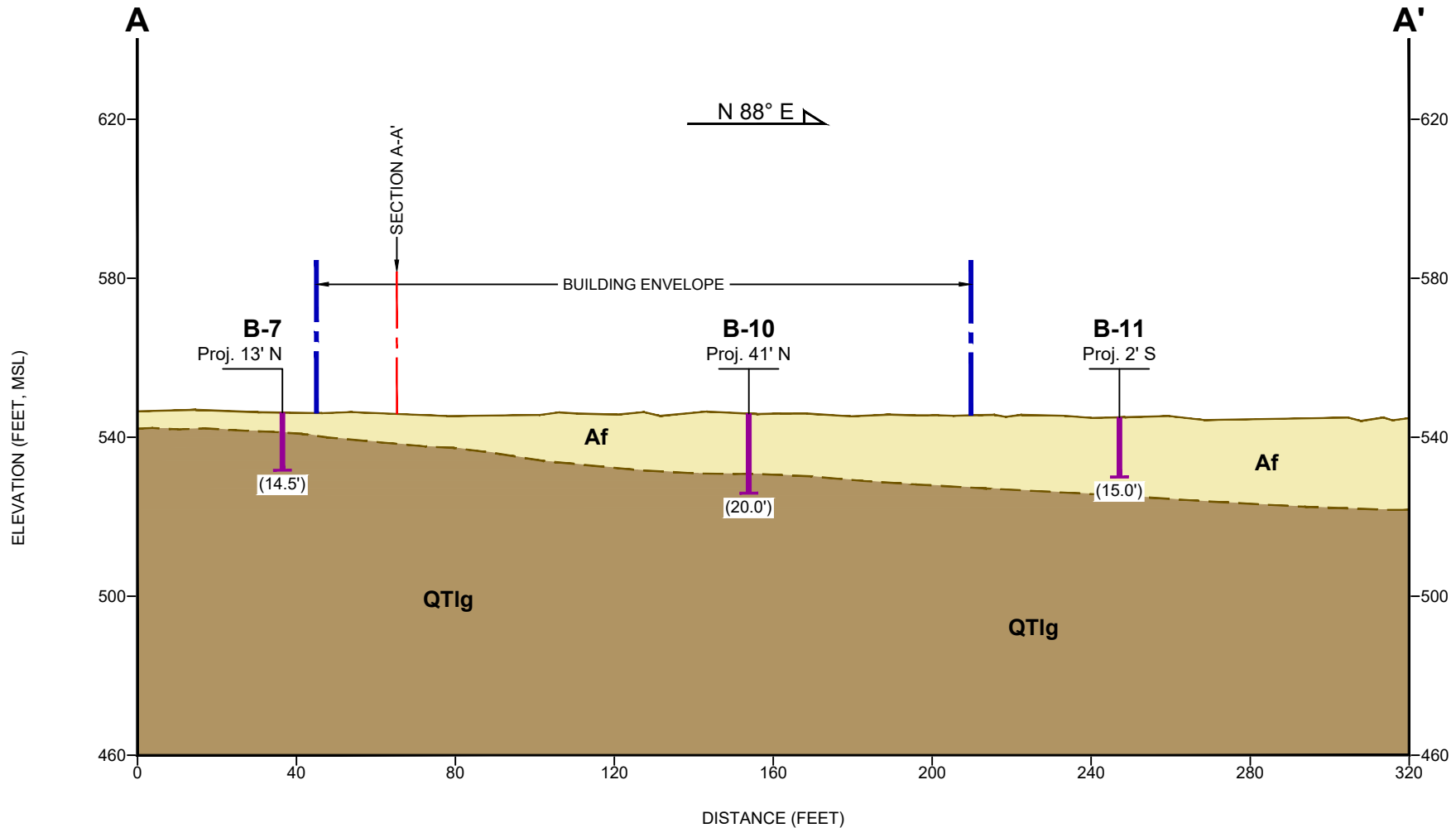


FIGURE 4

REGIONAL GEOLOGY

LAS POSITAS COLLEGE - AGRICULTURAL SCIENCE: HORTICULTURE FACILITY
3000 CAMPUS HILL DRIVE, LIVERMORE, CALIFORNIA



LEGEND

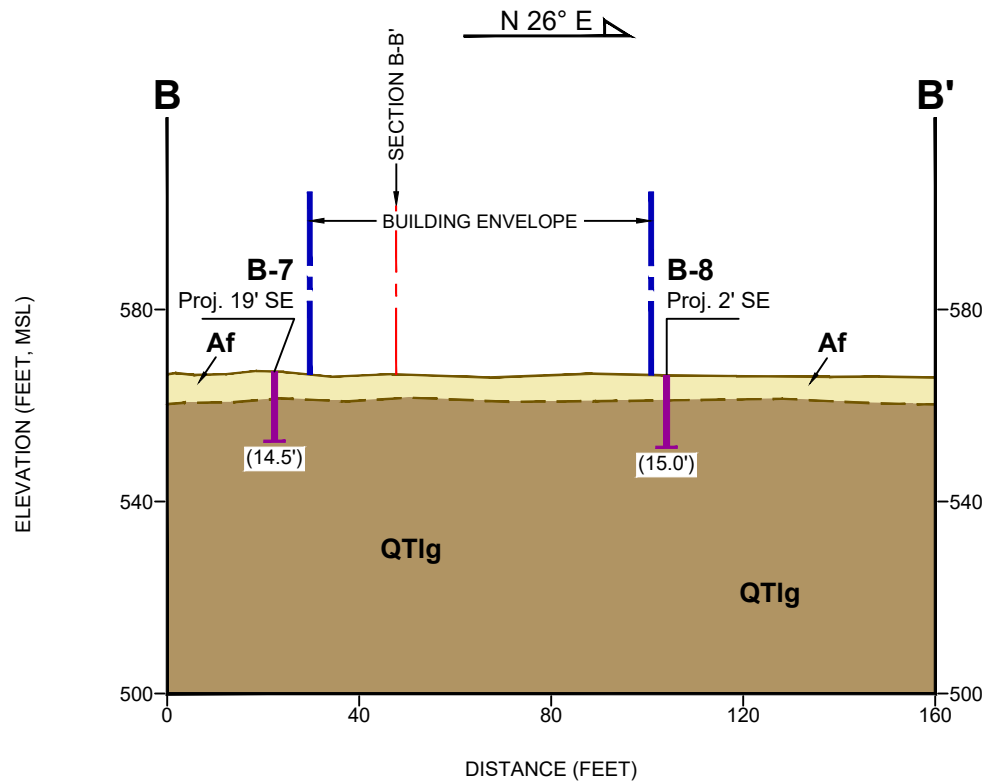
- Af** ARTIFICIAL FILL (NINYO & MOORE, 2011)
- QTlg** ALLUVIUM (LIVERMORE GRAVELS)
- GEOLOGIC CONTACT: APPROXIMATE
- MSL MEAN SEA LEVEL
- B-7** BORING
- (14.5') TOTAL DEPTH (FEET)

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE

FIGURE 5

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LEGEND

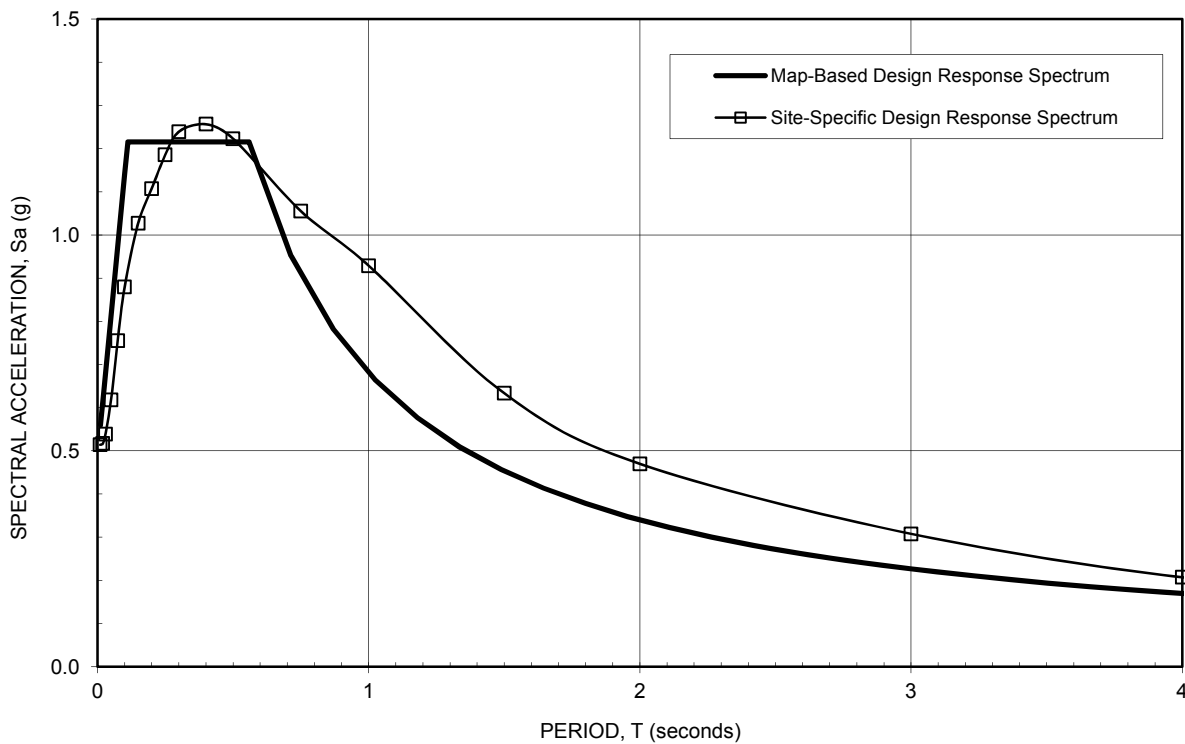
- Af** ARTIFICIAL FILL (NINYO & MOORE, 2011)
- QTlg** ALLUVIUM (LIVERMORE GRAVELS)
- GEOLOGIC CONTACT: APPROXIMATE
- MSL MEAN SEA LEVEL
- B-7** BORING
- (14.5') TOTAL DEPTH (FEET)

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE

FIGURE 6

PERIOD (seconds)	MAP-BASED DESIGN RESPONSE SPECTRUM Sa, (g)	SITE-SPECIFIC DESIGN RESPONSE SPECTRUM Sa, (g)
0.010	0.551	0.514
0.050	0.812	0.618
0.100	1.138	0.879
0.150	1.215	1.027
0.200	1.215	1.107
0.250	1.215	1.185
0.300	1.215	1.239
0.400	1.215	1.256
0.500	1.215	1.223
0.750	0.907	1.055
1.000	0.680	0.929

$S_{DS} = 1.131$	$S_{D1} = 0.950$	$S_{MS} = 1.696$	$S_{M1} = 1.425$	$PGA_M = 0.701$
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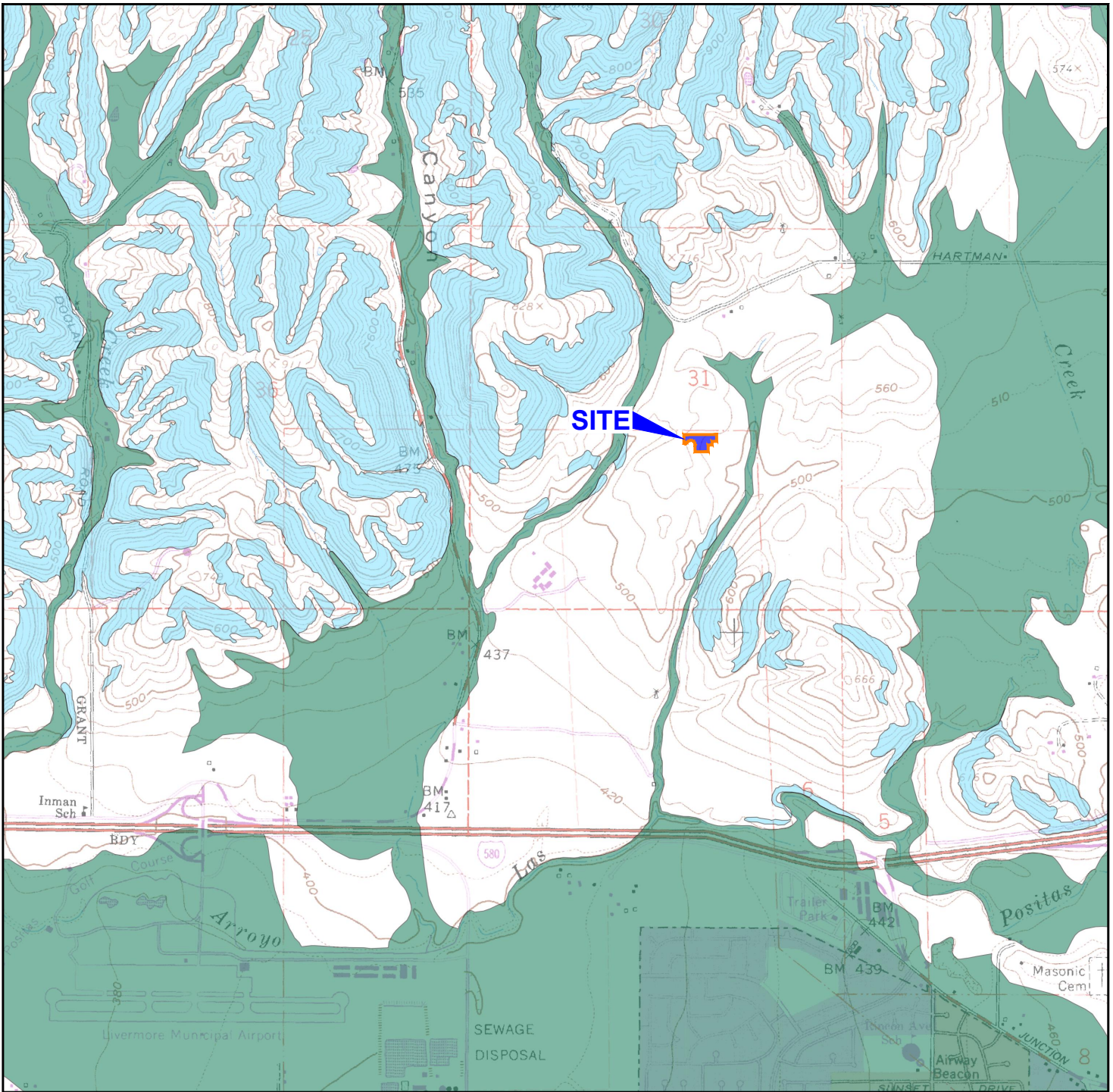


NOTES:

- 1 Site specific design response spectrum is two-thirds of the acceleration response spectrum that is associated with the maximum considered earthquake and is expected to achieve a 1% probability of collapse in a 50-year period (MCE_R). The MCE_R spectrum is computed as the lesser of probabilistic and deterministic spectral response accelerations at each period per ASCE 7-16 Section 21.2.3. The site specific design response spectrum conforms with the lower bound limit in ASCE 7-16 Section 21.3.
- 2 Probabilistic response spectrum is the 5% damped acceleration in the direction of maximum horizontal response associated with a ground motion having a 2% probability of exceedance in 50 years and adjusted for risk of collapse per Method 1 of ASCE 7-16 Section 21.2.1. Spectrum computed using UCERF3 mean earthquake forecast and the CY14, CB14, and BSSA14 attenuation relationships.
- 3 Deterministic response spectrum is the 84th percentile, 5% damped spectral response acceleration in the maximum horizontal direction computed using CY14, CB14, and BSSA14 attenuation relationships and considering a Mw 6.9 event on the Greenville fault about 6.8 km from the site and a Mw 6.6 event on the Mount Diablo Thrust Fault about 8.6 km from the site. Scaled to $1.5 \cdot F_a$ where appropriate.
- 4 Map-based design response spectrum is computed from mapped spectral ordinates, modified for Site Class D (Stiff Soil) conditions, in accordance with ASCE 7-16 Section 11.4. It is presented for comparison.

FIGURE 7

ACCELERATION RESPONSE SPECTRA



LEGEND



LIQUEFACTION ZONES:
 Areas where historic occurrence of liquefaction, or local geological, geotechnical, and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.



EARTHQUAKE-INDUCED LANDSLIDE ZONES:
 Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical, and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE
 REFERENCE: CGS, 1982, 2008

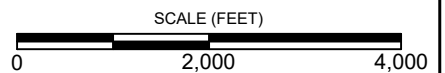


FIGURE 8

SEISMIC HAZARD ZONES

LAS POSITAS COLLEGE - AGRICULTURAL SCIENCE: HORTICULTURE FACILITY
 3000 CAMPUS HILL DRIVE, LIVERMORE, CALIFORNIA



APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following methods.

Modified Split-Barrel Drive Sampler

Relatively undisturbed soil samples were obtained in the field using a modified split-barrel drive sampler. The sampler, with an external diameter of 3.0 inches, was lined with 6-inch-long, thin brass liners with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass liners, sealed, and transported to the laboratory for testing.

Field Testing

The following test was performed in the field to evaluate soil properties.

Static Cone Penetrometer

A penetrometer with a conical tip having an apex angle of 60 degrees and a cone base area of 1.5 square centimeters was manually pushed 6 inches into the soil. The penetrometer was instrumented to measure the Cone Penetration Index (Qc) computed as the peak force on the cone divided by the cone base area. The Cone Penetration Index is reported in kilograms per square centimeter (ksc) on the boring logs at the depth of the test as a measure of the relative density or consistency of the soil encountered.

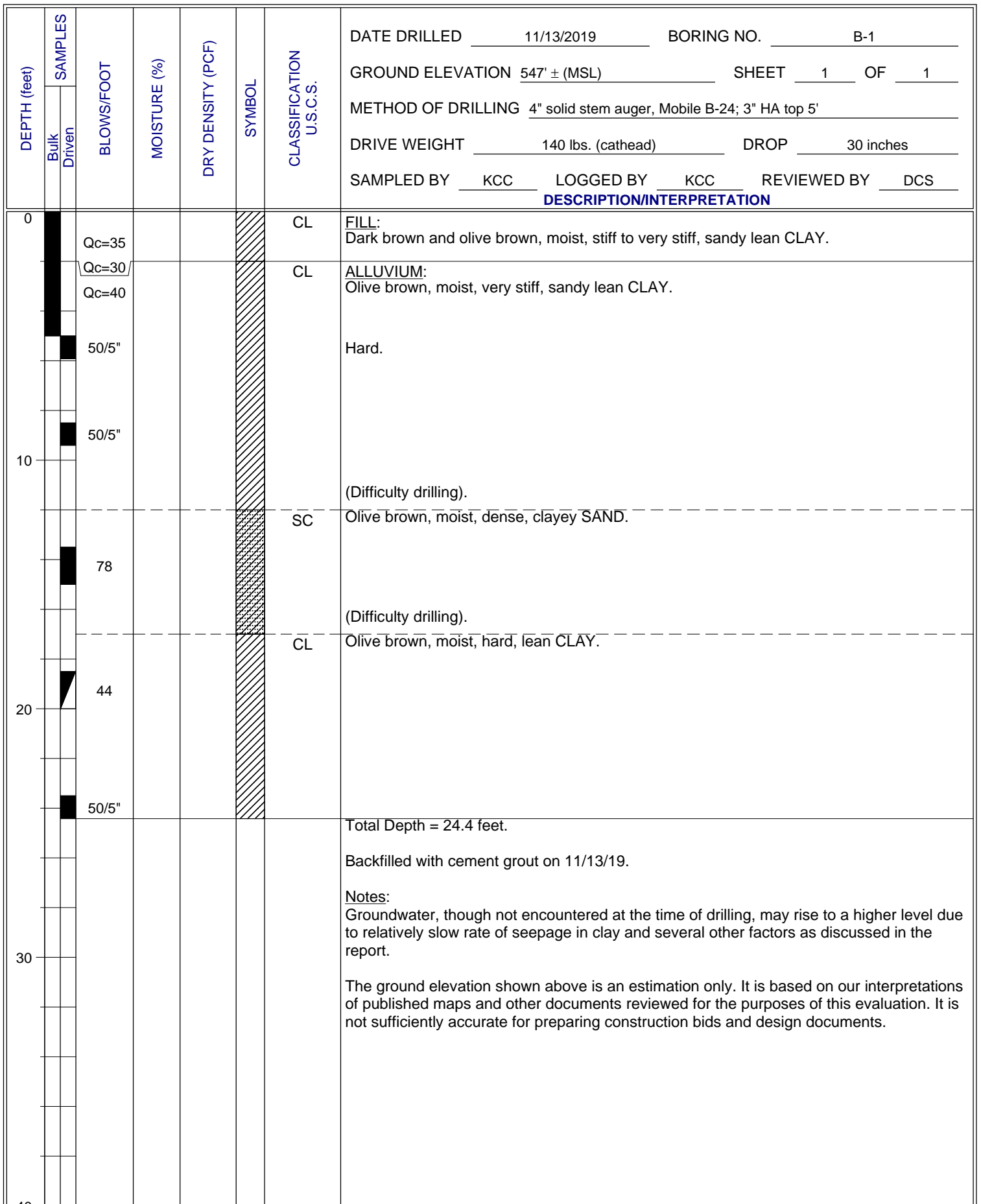


FIGURE A-1

DEPTH (feet)	BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
							11/13/2019	B-2	
							GROUND ELEVATION	SHEET	OF
							546' ± (MSL)	1	1
							METHOD OF DRILLING 4" solid stem auger, Mobile B-24; 3" HA top 5'		
							DRIVE WEIGHT	DROP	
							140 lbs. (cathead)	30 inches	
							SAMPLED BY	LOGGED BY	REVIEWED BY
							KCC	KCC	DCS
							DESCRIPTION/INTERPRETATION		
0		Qc=30				CL	FILL: Dark brown, moist, stiff, sandy lean CLAY.		
		Qc=45				CL	ALLUVIUM: Yellowish brown, moist, very stiff, sandy lean CLAY.		
		Qc=50					Olive brown, hard, lean CLAY; few sand. (Difficulty drilling).		
	90/11"		21.7	100.2		SC	Olive brown, moist, very dense, clayey SAND.		
	50/5"		15.1	102.3		CL	Olive brown, moist, hard, lean CLAY; few sand.		
10							Sandy.		
	47								
	50/5"								
20							Total Depth = 19.4 feet.		
							Backfilled with cement grout on 11/13/19.		
							<u>Notes:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.		
							The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.		
30									
40									

FIGURE A-2

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>11/13/2019</u> BORING NO. <u>B-3</u>	
	Bulk	Driven						GROUND ELEVATION <u>552' ± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>4" solid stem auger, Mobile B-24; 3" HA top 5'</u>	
								DRIVE WEIGHT <u>140 lbs. (cathead)</u> DROP <u>30 inches</u>	
								SAMPLED BY <u>KCC</u> LOGGED BY <u>KCC</u> REVIEWED BY <u>DCS</u>	
								DESCRIPTION/INTERPRETATION	
0							CL	FILL: Dark brown, dry, soft, lean CLAY.	
			Qc=15				CL	ALLUVIUM: Brown, moist, firm, lean CLAY.	
			Qc=17					Stiff.	
			Qc=18					Increase in sand content.	
			Qc=25					White and brown.	
			80/9"	20.1	98.7			Olive brown; hard; white carbonate lined fractures and nodules.	
			50/5"					Sandy.	
10								Total Depth = 9.4 feet.	
								Backfilled with cement grout on 11/13/19.	
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.	
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.	
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FIGURE A-3

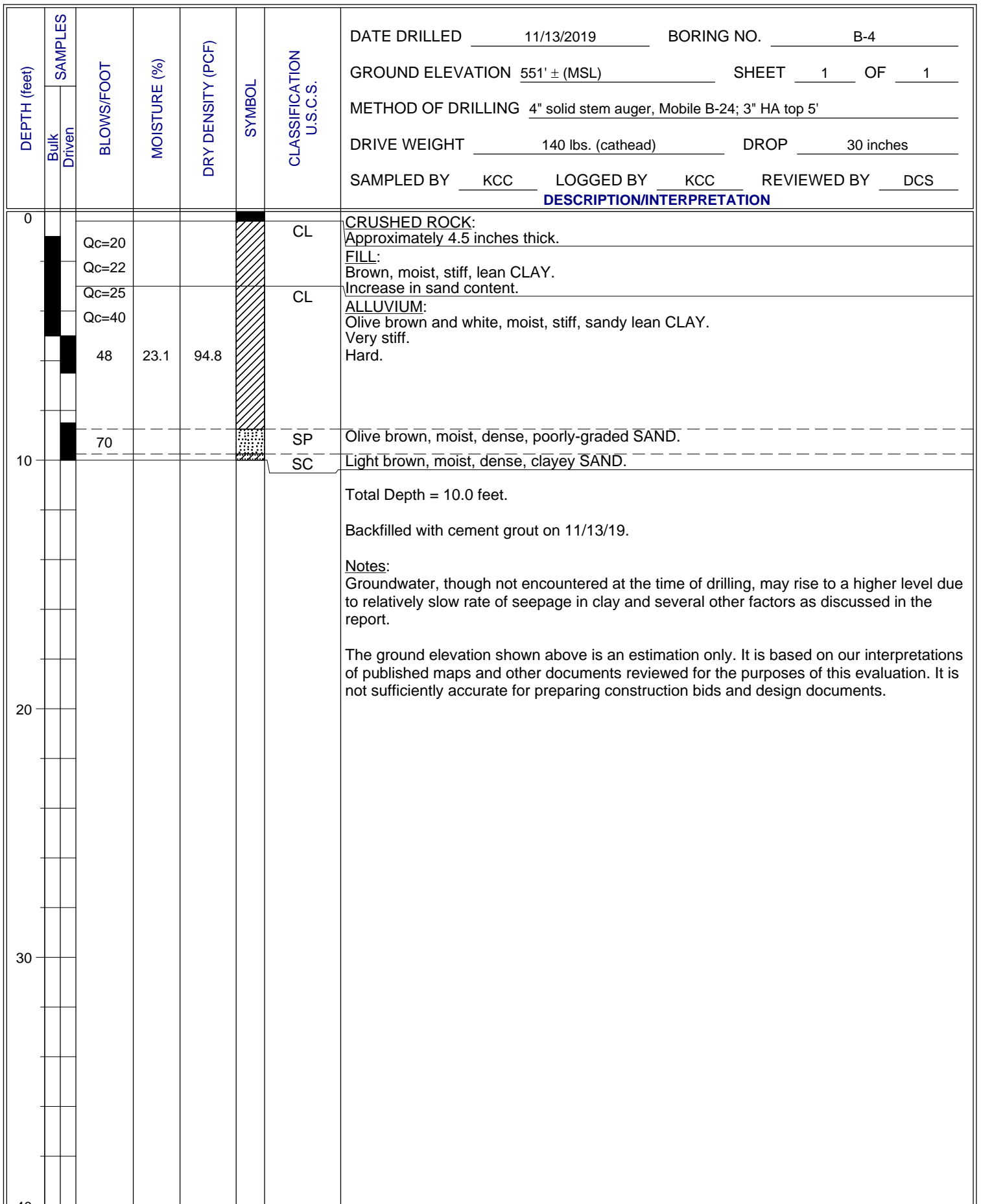


FIGURE A-4

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 11/13/2019 BORING NO. B-5	
	Bulk	Driven						GROUND ELEVATION 552' ± (MSL)	SHEET 1 OF 1
								METHOD OF DRILLING 4" solid stem auger, Mobile B-24; 3" HA top 5'	
								DRIVE WEIGHT 140 lbs. (cathead) DROP 30 inches	
								SAMPLED BY KCC LOGGED BY KCC REVIEWED BY DCS	
								DESCRIPTION/INTERPRETATION	
0							CL	CRUSHED ROCK: Approximately 4.5 inches thick. FILL: Brown, moist, stiff, lean CLAY. Increase in sand content.	
	Qc=20						CL	ALLUVIUM: Reddish brown to light brown, moist, stiff, lean CLAY.	
	Qc=25						CL		
	Qc=22						SC	Olive brown, moist, dense, clayey SAND.	
	90/11"		19.9	91.3			CL	Olive brown, moist, hard, sandy lean CLAY.	
	Qc=22						CL		
10	80		23.6	97.6			CL		
	80								
								Total Depth = 15.0 feet.	
								Backfilled with cement grout on 11/13/19.	
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.	
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30									
40									

FIGURE A-5

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>11/13/2019</u> BORING NO. <u>B-6</u>	
	Bulk	Driven						GROUND ELEVATION <u>550' ± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>3-inch diameter hand auger</u>	
								DRIVE WEIGHT <u>N/A</u> DROP <u>N/A</u>	
								SAMPLED BY <u>KCC</u> LOGGED BY <u>KCC</u> REVIEWED BY <u>DCS</u>	
DESCRIPTION/INTERPRETATION									
0							CL	FILL: Dark brown, moist, stiff, lean CLAY.	
			Qc=20						
			Qc=20						
			Qc=15				CL	ALLUVIUM: Olive brown, moist, firm, lean CLAY.	
								Total Depth = 5.0 feet.	
								Backfilled with on-site soil on 11/13/19.	
								<u>Notes:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.	
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.	
10									
20									
30									
40									

FIGURE A- 6

DEPTH (feet)	Bulk Driven SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
							3/3/2020	B-7	
							GROUND ELEVATION	SHEET	OF
							546' ± (MSL)	1	1
							METHOD OF DRILLING 4" solid stem auger, Mobile B-24; 3" HA top 5'		
							DRIVE WEIGHT	DROP	
							140 lbs. (cathead)	30 inches	
							SAMPLED BY	LOGGED BY	REVIEWED BY
							GL	GL	DCS
							DESCRIPTION/INTERPRETATION		
0		Qc=32				CL	FILL: Dark brown to light brown, moist, very stiff, sandy lean CLAY. Light brown.		
		35	18.7	94.5					
		36	23.8	96.0		CH	ALLUVIUM: Dark brown, moist, very stiff, sandy fat CLAY.		
		42							
10		45	26.7	92.0		CL	Light brown, moist, hard, sandy lean CLAY; white calcium carbonate lined fractures and nodules. Olive brown; few sand.		
		50/6"							
							Total Depth = 14.5 feet. Backfilled with cement grout on 3/3/2020. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.		
20									
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40									

FIGURE A-7

DEPTH (feet)	Bulk Driven SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
							3/3/2020	B-8	
							GROUND ELEVATION	SHEET	OF
							545' ± (MSL)	1	1
							METHOD OF DRILLING 4" solid stem auger, Mobile B-24; 3" HA top 5'		
							DRIVE WEIGHT	DROP	
							140 lbs. (cathead)	30 inches	
							SAMPLED BY	LOGGED BY	REVIEWED BY
							GL	GL	DCS
							DESCRIPTION/INTERPRETATION		
0		Qc=31				CL	FILL: Dark brown to light brown, moist, very stiff, sandy lean CLAY; trace gravel.		
		37	19.8	100.7		SC	Light brown. Light brown, moist, medium dense, clayey SAND.		
		37				CH	ALLUVIUM: Dark brown, moist, very stiff, fat CLAY.		
		44					Hard.		
10						CL	Olive brown, moist, hard, sandy lean CLAY; white carbonate lined fractures and nodules.		
		46					Total Depth = 15.0 feet.		
							Backfilled with on-site soil on 3/03/2020.		
							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.		
							The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.		
20									
30									
40									

FIGURE A- 8

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>3/3/2020</u> BORING NO. <u>B-9</u>	
	Bulk	Driven						GROUND ELEVATION <u>544' ± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>4" solid stem auger, Mobile B-24; 3" HA top 5'</u>	
								DRIVE WEIGHT <u>140 lbs. (cathead)</u> DROP <u>30 inches</u>	
								SAMPLED BY <u>GL</u> LOGGED BY <u>GL</u> REVIEWED BY <u>DCS</u>	
DESCRIPTION/INTERPRETATION									
0			Qc=24				CL	FILL: Brown to light brown, moist, stiff, sandy lean CLAY.	
			25	19.0	99.3		SC	Brown to light brown, moist, medium dense, clayey SAND.	
			28	21.1	96.3		CL	Brown, moist, very stiff, sandy lean CLAY.	
10			28	21.9	94.0			Olive brown; white carbonate nodules.	
			45				CH	ALLUVIUM: Dark brown, moist. hard, sandy fat CLAY.	
								Total Depth = 15.0 feet.	
								Backfilled with on-site soil on 03/03/2020.	
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.	
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.	
20									
30									
40									

FIGURE A-9

DEPTH (feet)	Bulk Driven SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>3/3/2020</u> BORING NO. <u>B-10</u>
							GROUND ELEVATION <u>544' ± (MSL)</u> SHEET <u>1</u> OF <u>1</u>
							METHOD OF DRILLING <u>4" solid stem auger, Mobile B-24; 3" HA top 5'</u>
							DRIVE WEIGHT <u>140 lbs. (cathead)</u> DROP <u>30 inches</u>
							SAMPLED BY <u>GL</u> LOGGED BY <u>GL</u> REVIEWED BY <u>DCS</u>
							DESCRIPTION/INTERPRETATION
0		Qc=25				SC	FILL: Brown, moist, medium dense, clayey SAND; trace gravel.
		24	20.5	101.8		CL	Light brown and dark brown, moist, very stiff, sandy lean CLAY.
		32	20.4	94.4			
10		27					Dark brown, olive brown, and brown; decrease in sand content.
		45					Olive brown, hard; white carbonate nodules.
20		55				CH	ALLUVIUM: Dark brown, moist, hard, fat CLAY.
							Total Depth = 20.0 feet. Backfilled with on-site soil on 03/03/2020. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
30							
40							

FIGURE A- 10

DEPTH (feet)	BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
							3/3/2020	B-11	
							GROUND ELEVATION	SHEET	OF
							543' ± (MSL)	1	1
							METHOD OF DRILLING 4" solid stem auger, Mobile B-24; 3" HA top 5'		
							DRIVE WEIGHT	DROP	
							140 lbs. (cathead)	30 inches	
							SAMPLED BY	LOGGED BY	REVIEWED BY
							GL	GL	DCS
							DESCRIPTION/INTERPRETATION		
0						SC	AGGREGATE BASE: Approximately 5 inches thick.		
		22	21.6	97.9			FILL: Olive brown, moist, medium dense, clayey SAND.		
		24	20.3	103.9					
10		32					Olive brown and dark brown.		
		26				CL	Dark brown, olive brown, and gray, moist, very stiff, lean CLAY.		
							Total Depth = 15.0 feet.		
							Backfilled with on-site soil on 03/03/2020.		
							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to relatively slow rate of seepage in clay and several other factors as discussed in the report.		
							The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.		
20									
30									
40									

FIGURE A- 11



APPENDIX B

Laboratory Testing

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests

The moisture content of samples obtained from the exploratory borings was evaluated in accordance with ASTM D 2216. The dry density of relatively undisturbed samples obtained from the exploratory borings was evaluated in accordance with ASTM D 2937. The test results are presented on the boring logs in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in accordance with ASTM D 422. The grain-size distribution curves are shown on Figures B-1 through B-9. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

Atterberg Limits

Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in accordance with ASTM D 4318. These test results were utilized to evaluate the soil classification in accordance with the USCS. The test results and classifications are shown on Figure B-10.

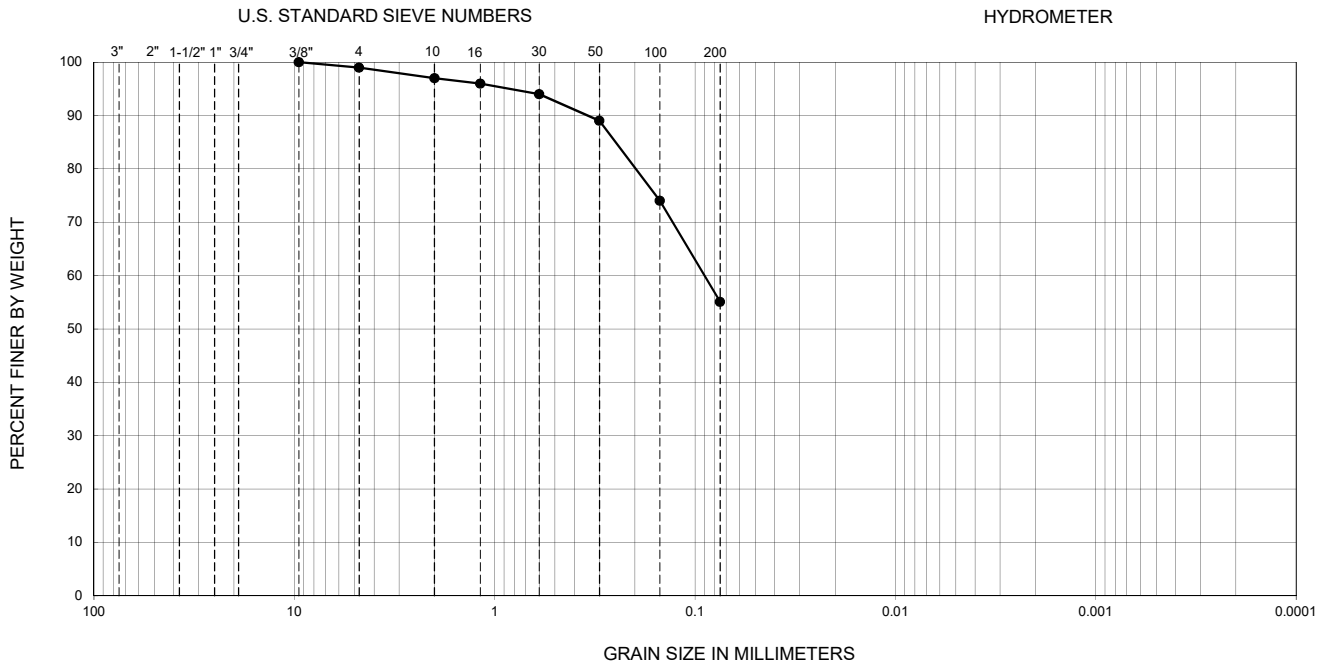
Expansion Index Tests

The expansion indices of selected materials were evaluated in accordance with ASTM D 4829. The specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 1 percent). The prepared 1-inch-thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The test results are presented on Figure B-11.

Soil Corrosivity Tests

Soil pH, and resistivity tests were performed on representative samples in accordance with California Test (CT) 643. The soluble sulfate and chloride content of the selected samples were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are presented on Figure B-12.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



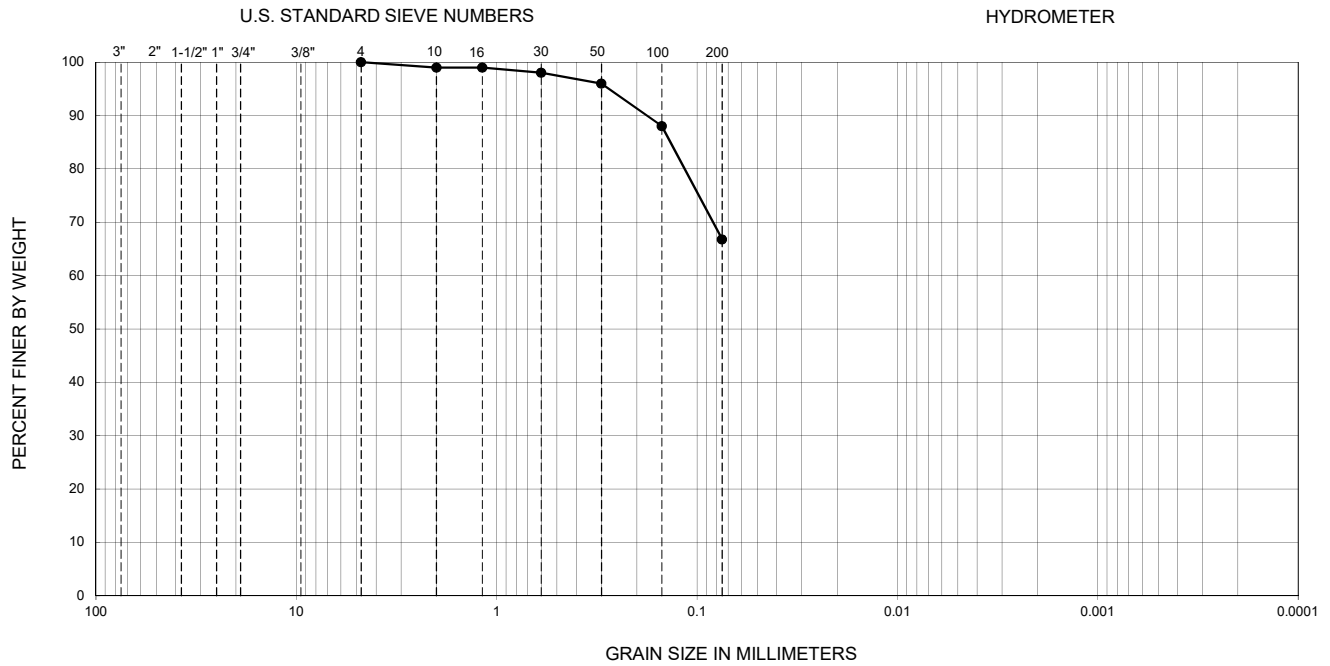
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-1	0.0-5.0	--	--	--	--	--	0.09	--	--	55	CL

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-1

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



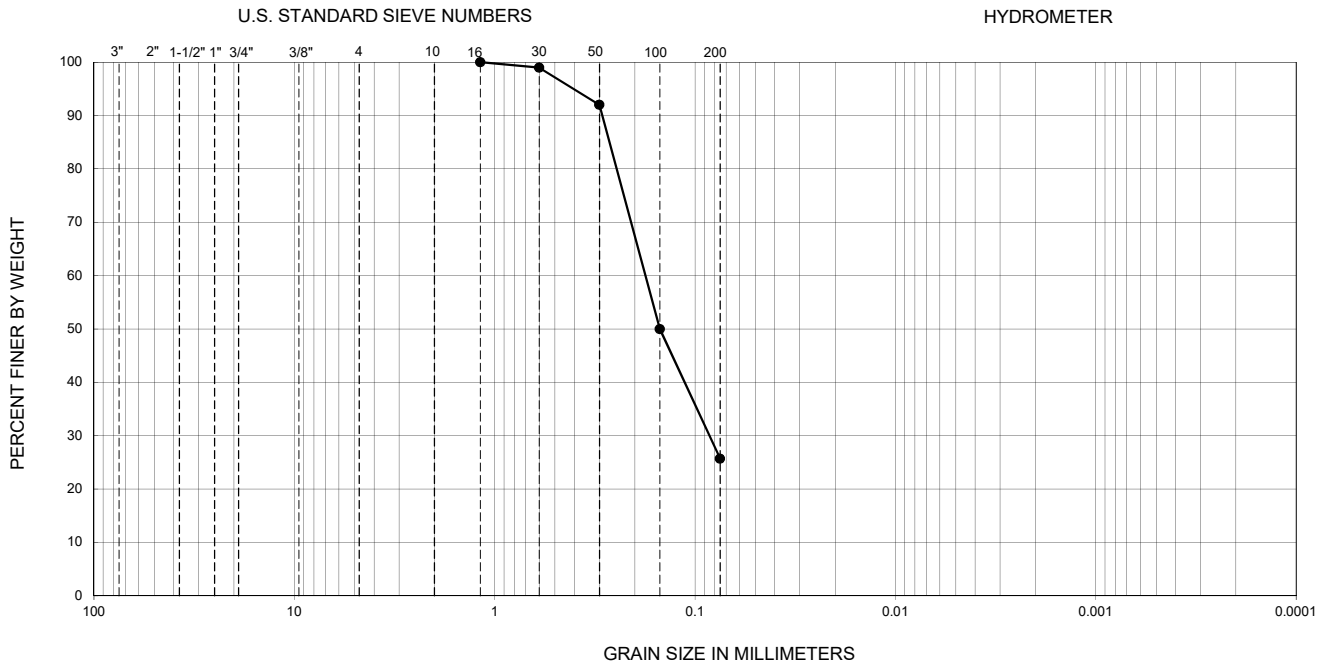
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-1	9.0-9.5	--	--	--	--	--	--	--	--	67	CL

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-2

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



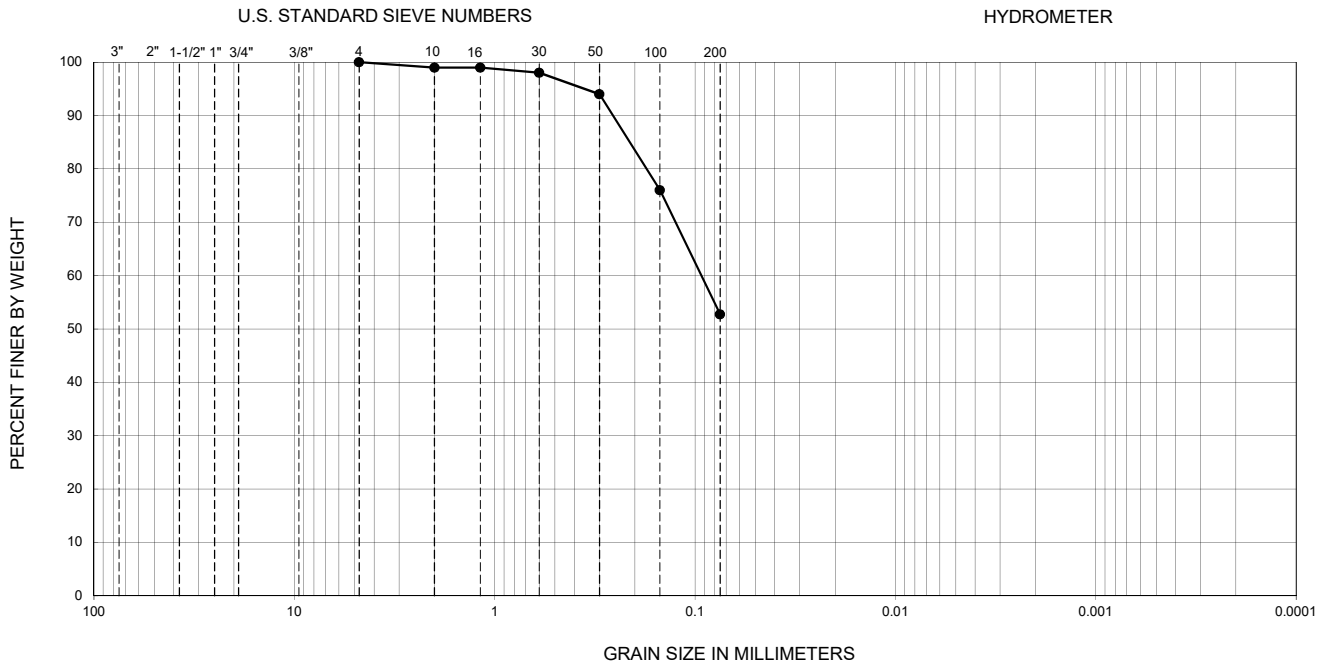
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-1	14.0-14.5	--	--	--	--	0.09	0.19	--	--	26	SC

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-3

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



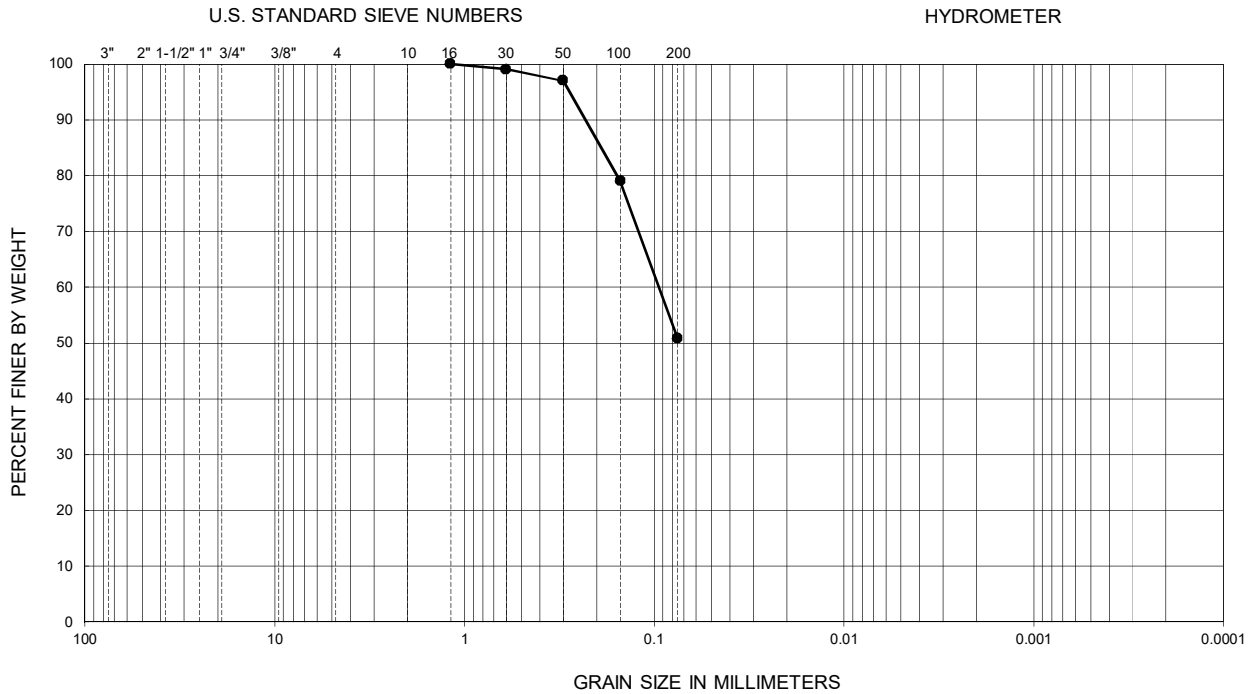
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-4	5.5-6.0	--	--	--	--	--	0.10	--	--	53	CL

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-4

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-7	9.5-10.0	--	--	--	--	--	0.10	--	--	51	CL

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-5

GRADATION TEST RESULTS

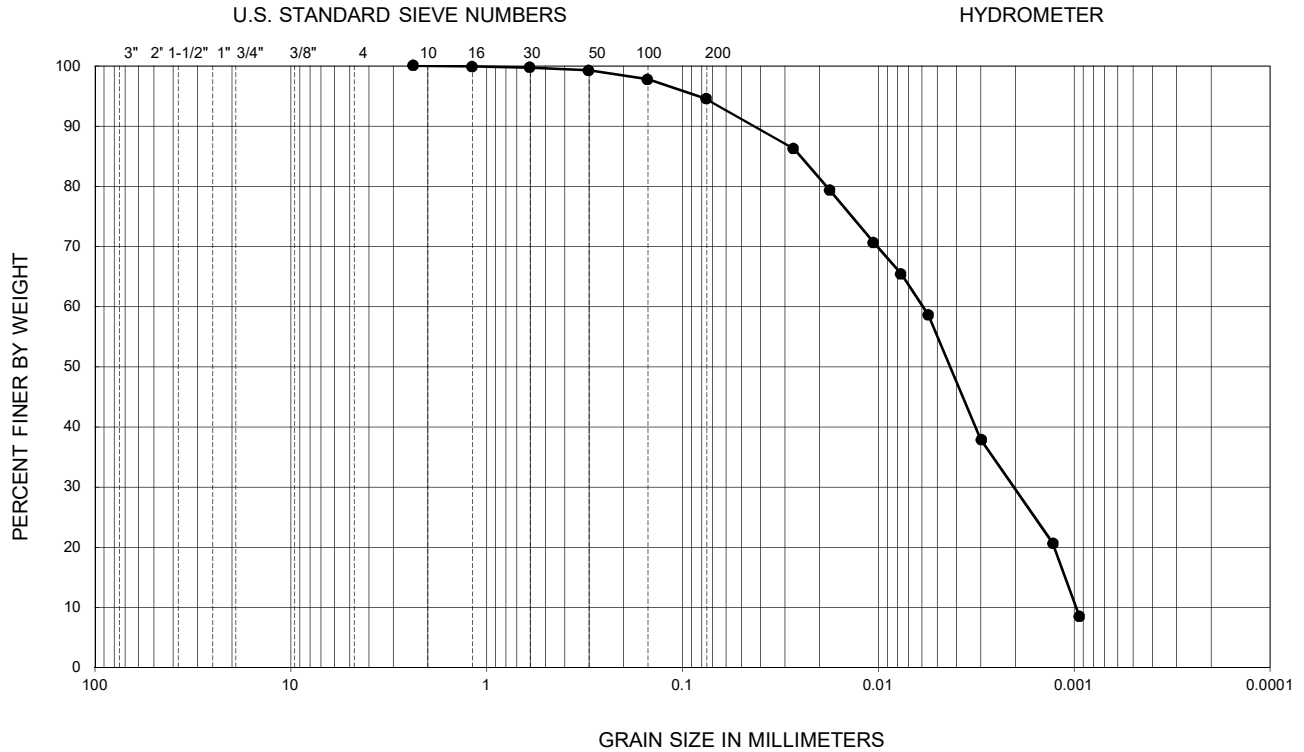


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GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (%)	USCS
●	B-7	11.0-11.5	--	--	--	0.001	0.002	0.006	6.1	0.8	94	CL

PERFORMED IN ACCORDANCE WITH ASTM D 422

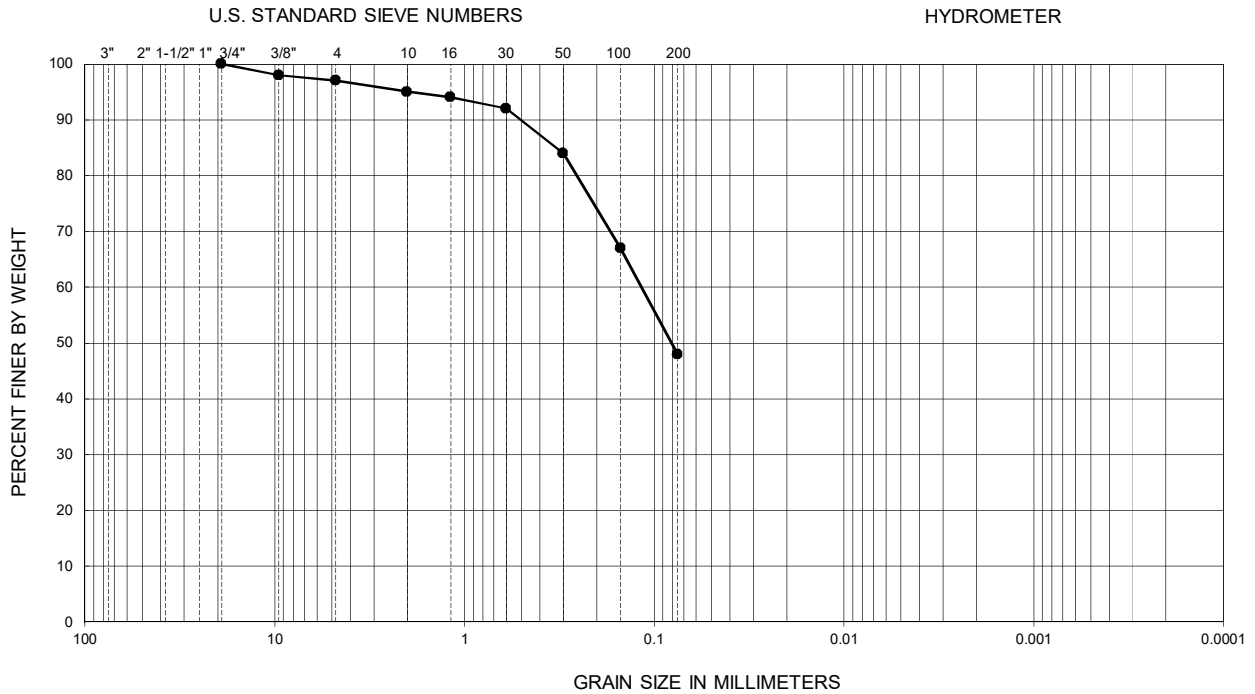
FIGURE B-6

GRADATION TEST RESULTS



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GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



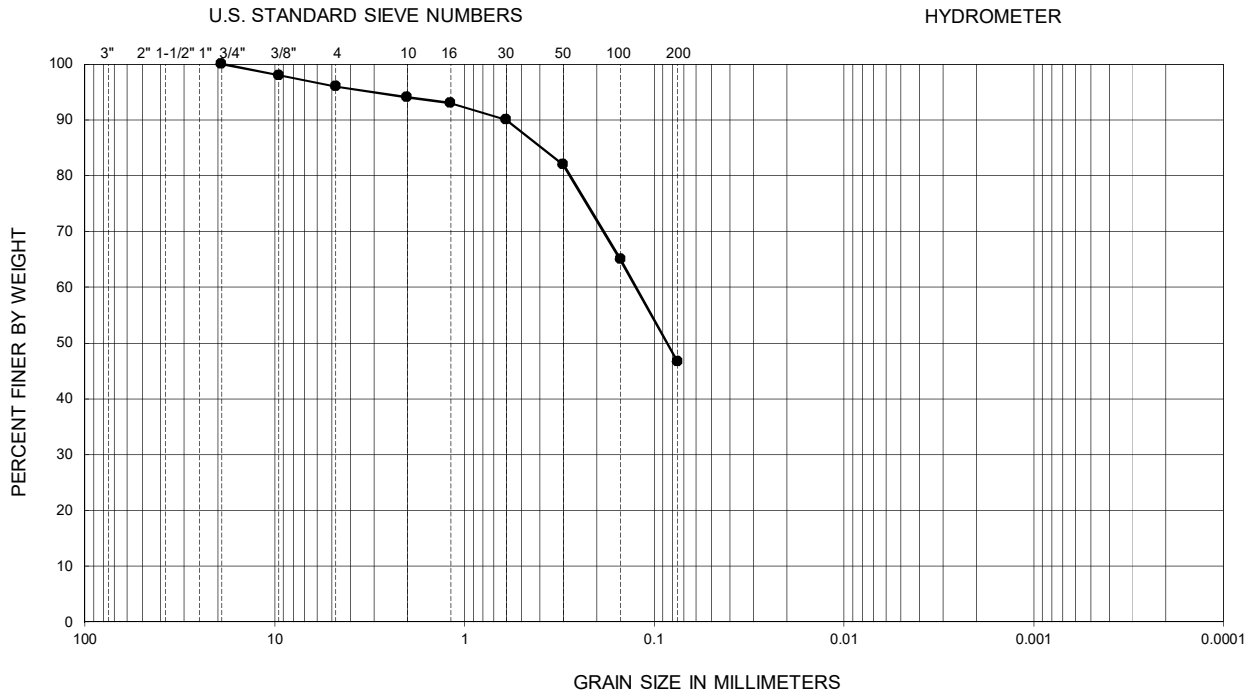
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-8	3.0-3.5	--	--	--	--	--	0.12	--	--	48	SC

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-7

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



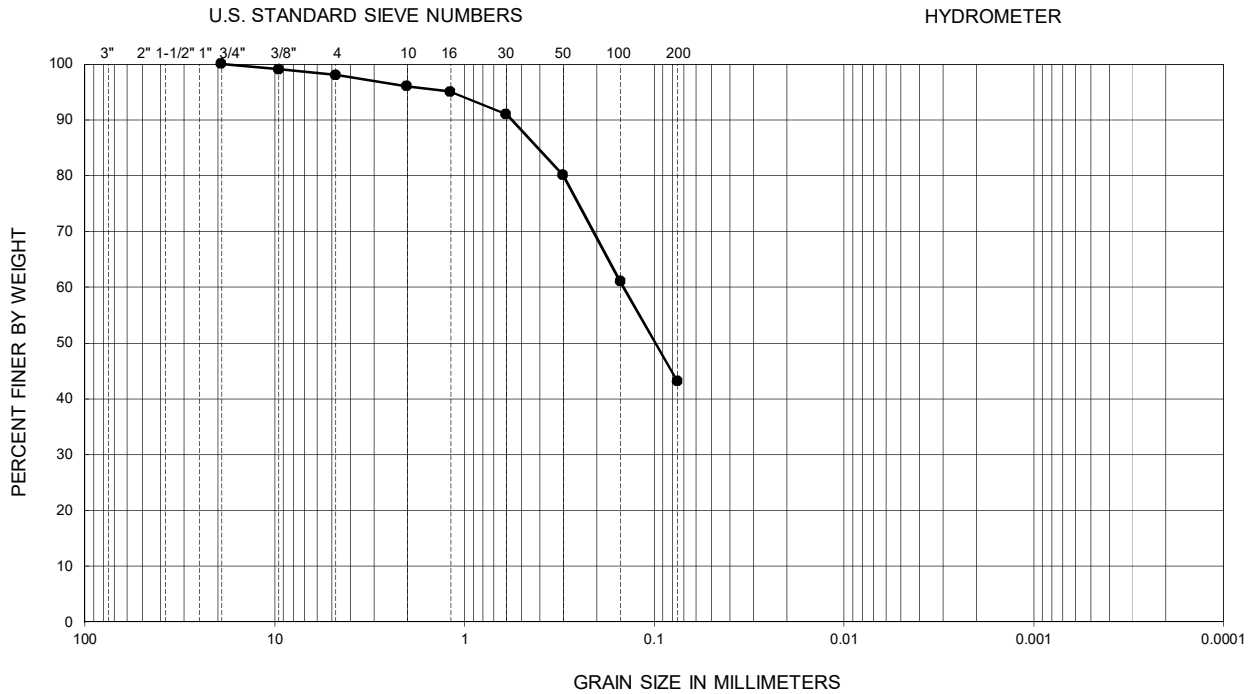
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-9	3.0-3.5	--	--	--	--	--	0.13	--	--	47	SC

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-8

GRADATION TEST RESULTS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D ₁₀	D ₃₀	D ₆₀	C _u	C _c	Passing No. 200 (percent)	USCS
●	B-11	2.5-3.0	--	--	--	--	--	0.15	--	--	43	SC

PERFORMED IN ACCORDANCE WITH ASTM D 422 / D6913

FIGURE B-9

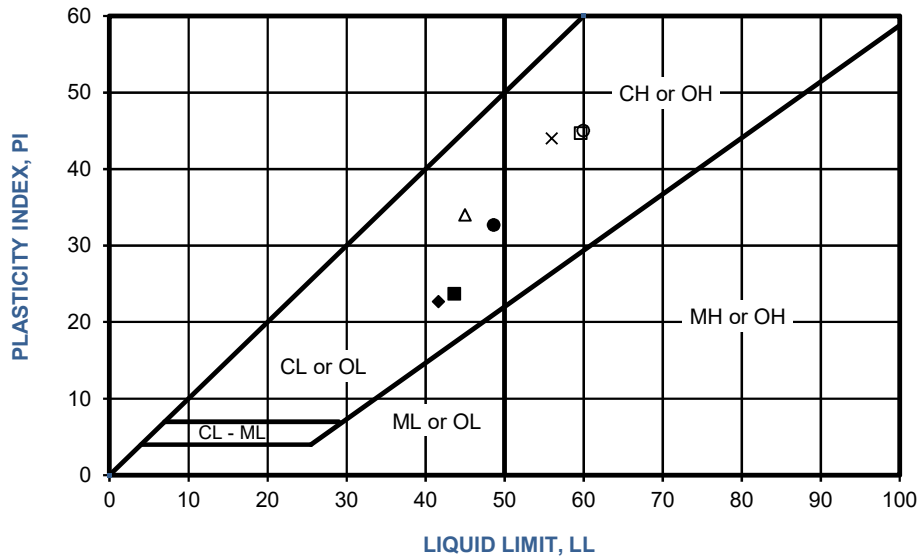
GRADATION TEST RESULTS



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SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-1	5.0-5.5	49	16	33	CL	CL
■	B-2	5.0-5.5	44	20	24	CL	CL
◆	B-5	9.0-9.5	42	19	23	CL	CL
○	B-7	6.0-6.5	60	15	45	CH	CH
□	B-8	6.0-6.5	60	15	45	CH	CH
△	B-10	2.5-3.0	45	11	34	CL	CL
x	B-10	19.5-20.0	56	12	44	CH	CH



PERFORMED IN ACCORDANCE WITH ASTM D 4318

FIGURE B-10

SAMPLE LOCATION	SAMPLE DEPTH (ft)	INITIAL MOISTURE (percent)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (percent)	VOLUMETRIC SWELL (in)	EXPANSION INDEX	POTENTIAL EXPANSION
B-1	0.0-5.0	15.5	93.3	31.4	0.053	53	Medium
B-4	0.0-3.0	11.7	102.5	26.6	0.074	74	Medium
B-7	0.0-1.0	13.4	98.5	28.8	0.074	74	Medium

PERFORMED IN ACCORDANCE WITH ASTM D 4829

FIGURE B-11

EXPANSION INDEX TEST RESULTS



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SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH ¹	RESISTIVITY ¹ (ohm-cm)	SULFATE CONTENT ²		CHLORIDE CONTENT ³ (ppm)
				(ppm)	(%)	
B-1	0.0-5.0	7.8	820	50	0.005	390
B-4	0.0-3.0	7.6	1,800	2460	0.246	390
B-9	0.0-5.0	6.8	900	40	0.004	160

¹ PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 643

² PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 417

³ PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE B-12

CORROSIVITY TEST RESULTS



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APPENDIX C

Percolation Testing

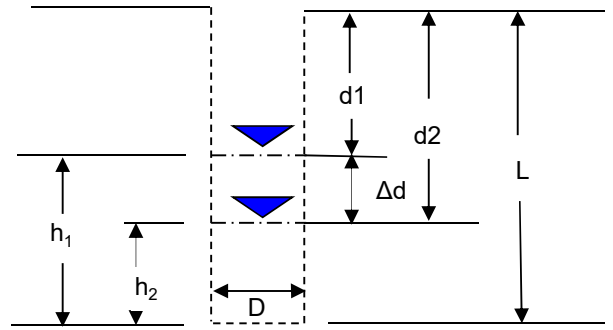
APPENDIX C

PERCOLATION TESTING

Field Procedure for Percolation Testing

The infiltration characteristics of the site soil were evaluated by field percolation testing. The test hole was excavated with hand tools to a depth of approximately 2½ feet, with a diameter of about 5 inches. The subsurface conditions encountered in the test hole consisted of lean clay. The test hole location is depicted on Figure 2. After cleaning the test hole of loose material, water was added to the test hole to achieve a water level approximately 6 inches above the bottom of the test hole. The drop in the water level was recorded over periodic intervals. Water was added to the test hole between measurement intervals to maintain sufficient water levels in the hole for percolation. The percolation rate reported is the percolation rate over the last measurement interval. The infiltration rate is the percolation rate adjusted by a reduction factor to exclude exfiltration occurring through the sidewalls of the test hole. The results of the percolation testing are presented on Figure C-1.

Project = LAS POSITAS COLLEGE - HORTICULTURE FACILITY
 Project No. = 401294035
 Depth of Boring, L (ft) = 2.5
 Diameter of Boring, D (in) = 5.0
 Diameter of Pipe (in) = 5.0
 Initial Depth to Water, d1 (in), (Final Period) = 24.00
 Initial Height of Water, h1 (in), (Final Period) = 6.00
 Water Level Drop, Δd (in), (Final Period) = 0.25
 Reduction factor, Rf = 3.4
 $h1 = L - d1$ (in inches)
 $Rf = ((2h1 - \Delta d)/DIA) + 1$



Test No. (Hole No.)	Time (hr:min)	Elapsed Time (min)	Depth to Water, d (in)	Water Level, h (in)	Change in Water Level, Δd (in)	Time Interval (hour)	Percolation Rate (inch/hour)	Adjusted Percolation Rate (inch/hour)
P-1	8:43		24.00	6.00				
	8:58	15	24.50	5.50	0.50	0.25	2.0	0.60
	8:58		24.00	6.00				
	9:13	15	24.50	5.50	0.50	0.25	2.0	0.60
	9:13		24.00	6.00				
	9:28	15	24.50	5.50	0.50	0.25	2.0	0.60
	9:28		24.00	6.00				
	9:43	15	24.25	5.75	0.25	0.25	1.0	0.30
	9:43		24.00	6.00				
	9:58	15	24.25	5.75	0.25	0.25	1.0	0.30
	9:58		24.00	6.00				
	10:13	15	24.25	5.75	0.25	0.25	1.0	0.30
	10:13		24.00	6.00				
	10:28	15	24.25	5.75	0.25	0.25	1.0	0.30
	10:28		24.00	6.00				
	10:43	15	24.25	5.75	0.25	0.25	1.0	0.34
	10:43		24.00	6.00				
	10:58	15	24.25	5.75	0.25	0.25	1.0	0.30
	10:58		24.00	6.00				
	11:13	15	24.25	5.75	0.25	0.25	1.0	0.30
11:13		24.00	6.00					
11:28	15	24.25	5.75	0.25	0.25	1.0	0.30	

FIGURE C-1

PERCOLATION TEST RESULTS



LAS POSITAS COLLEGE - AGRICULTURAL SCIENCES: HORTICULTURE FACILITY
 3000 CAMPUS HILL DRIVE, LIVERMORE, CALIFORNIA



APPENDIX D

Geophysical Survey

APPENDIX D

GEOPHYSICAL SURVEY

Scope

A seismic survey using passive surface wave techniques was performed at the site on February 1, 2020. Surveys were performed along one line using passive techniques. The survey line location is noted on Figure 2. The purpose of the study was to evaluate the subsurface shear-wave velocity at a representative location.

Passive Surface Wave Techniques

The passive surface wave method provided a shear wave velocity model to a depth of approximately 100 feet below the ground surface (bgs) and V_{s100} for seismic site classification (CBC, 2019). The passive seismic method carried out included Microtremor Array Measurements (MAM) and consisted of one linear profile of seismic data collection. The following sections provide a summary of the methods and analyses used in our study. The seismic model results are provided on Figure D-1.

Field Methods

A Geode 24–Channel Seismograph (Geometrics Inc., San Jose, California) was used for the MAM survey, with 4.5 Hertz (Hz) vertical component geophone placed at intervals of approximately 10-feet for a total profile length of 230 feet. Approximately twenty records were collected, with a record length of 30 seconds (s) and a 2 millisecond (ms) sampling interval. The field data were digitally recorded in SEG2 format, reviewed in the field for data quality, saved to a hard disk, and documented.

Data Processing and Modeling

The MAM seismic data were processed using SeisImager (Geometrics Inc., San Jose, California) seismic processing software. The dispersive characteristics of surface waves are used to evaluate the subsurface velocity at depth. Longer wavelength (longer-period and lower-frequency) surface waves travel deeper and thus contain more information about deeper velocity structure. Shorter wavelength (shorter-period and higher-frequency) surface waves travel relatively shallow within the earth and thus contain more information about velocity closer to the surface. The dispersion is dependent on the material properties, such as surface wave velocity, relative material densities, and Poisson's ratio. An inversion is performed on the collected passive seismic shear wave records within SeisImager to produce a model of the variation in shear wave velocities with depth. The following data processing flow was used to calculate Average Shear-wave Velocities (AVS) to a depth of approximately 100 feet (V_{s100}).

- Collated records into list file and edited any bad channels or records,
- Applied 2D Spatial Auto Correlation (SPAC); using a linear array and 24 geophones at 10 feet spacing,
- Phase velocity frequency transformation from 2 to 20 Hz
- Automated velocity picks of raw phase velocity were calculated and updated manually,
- Created an initial model and carried out a non-linear Least Squares Method (LSM) inversion to produce a final shear wave velocity model; convergence of the inversion was judged whether the model achieved an RMS <5% within 5-7 iterations,
- Calculated V_{s100} using final shear wave velocity model.

Results

Shear wave data resolution generally decreases with depth, due to the loss of sensitivity of the dispersion curve to changes in shear wave velocity as depth increases. Our MAM seismic modeling results are provided on Figure D-1. The layered model in Figure D-1 indicates our interpretation of the approximate changes in shear wave velocity vertically with depth across the surveyed location.

The model results indicate a $V_{s100'}$ value of 984 feet/sec. Accordingly, the site is interpreted to have a Seismic Site Classification of Class D.

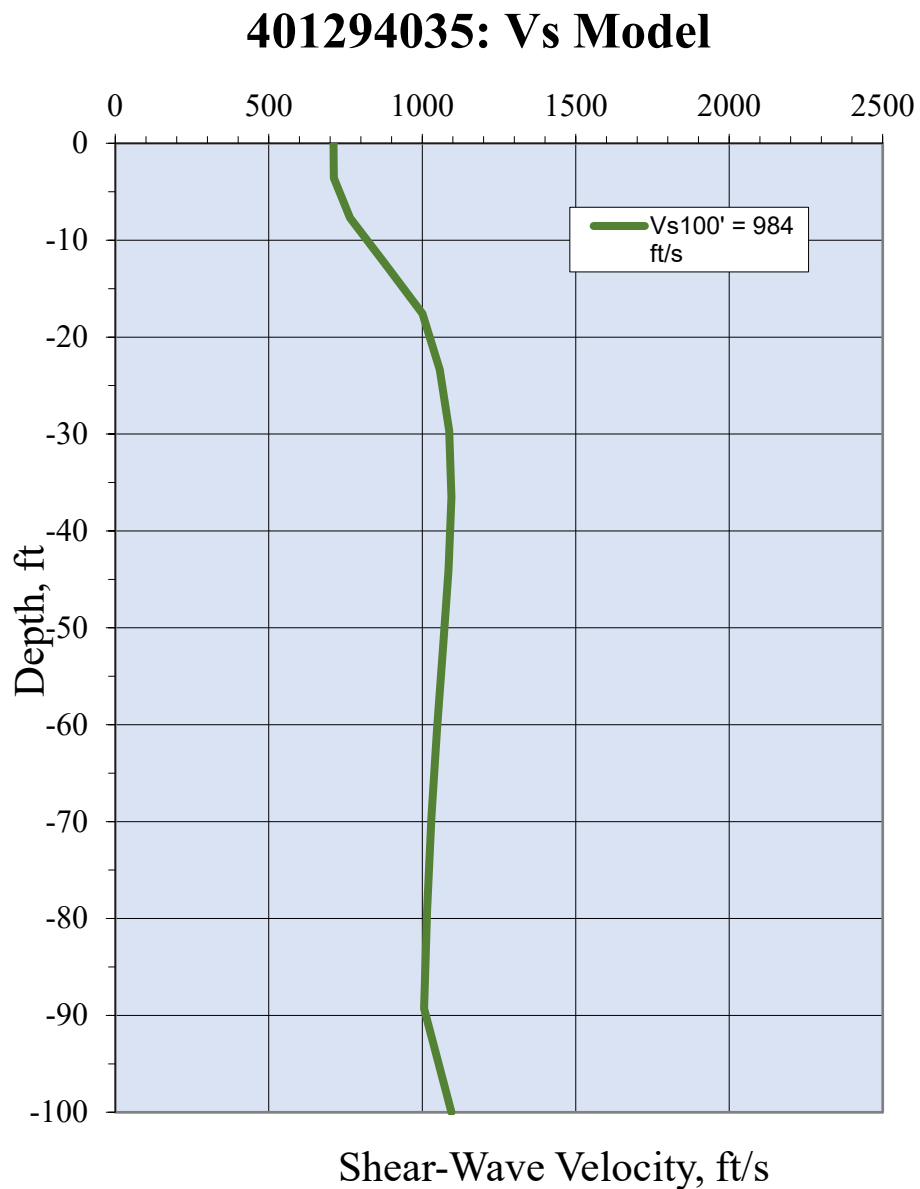


Figure D-1 MAM Shear Wave Velocity Model Results



APPENDIX E

Ground Motion Calculations

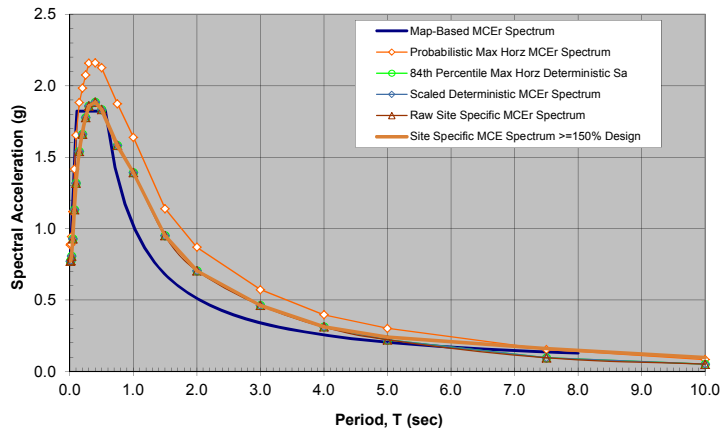
Vs30 (mps)	Site Class	Spectral Response Mapped Values		Site Coefficients		Spectral Response Adjusted for Site Effects		Design Spectral Response		Period at 0.2*Ts	Period at S _{D1} /S _{DS}	Long-Period Transition
		S _s	S ₁	F _a	F _v	S _{ms}	S _{m1}	S _{ds}	S _{d1}	T ₀	T _s	T _L
298	D	1.823	0.600	1.000	1.700	1.823	1.020	1.215	0.680	0.112	0.560	8.0
Default?	FALSE	Design Spectrum Limit:		1.000	2.500	1.823	1.500	1.215	1.000	0.165	0.823	8.0
		Deterministic Limit:		1.000	2.500							

Risk Coefficients		(C _{R1} -C _{RS})	PGA Site Coefficient	Mapped Adjusted PGA	ASCE 7-16 Sec. 21.5
C _{RS}	C _{R1}	Ratio	F _{PGA}	PGA _M	PGA
0.93	0.923	-0.00875	1.100	0.819	0.701

Probabilistic MCE Spectrum 2% chance of exceedance in 50 years with 5% damping using OPENSHA						Probabilistic MCE _R Spectrum		84th Percentile DSHA Spectral Response in Maximum Horizontal Direction					Deterministic MCE _R Spectrum 1.5Fa Scaled	Site-Specific MCE _R	SS MCE _R ≥ 150% of SS Design S _a
Chiou & Youngs (2014) GMRot150	Campbell & Bozorgnia (2014) GMRot150	Boore et al (2014) GMRot150	Max Horz Direction Response to Geomean	Average x Max Horz Direction to Geomean	PMH S _a	Risk targeted for 1% chance of collapse in 50 years, using Method 1 (ASCE 7-16 Sec 21.2.1.1)	Chiou & Youngs (2014) 84%ile GM	Campbell & Bozorgnia (2014) 84%ile GM	Boore et al (2014) 84%ile GM	Max Horz Direction Response to Geomean	Average x Max Horz Direction to Geomean	Maximum between 84th percentile Sa and Det. Limit	Sam	Sam	
Period	CY Sa	CB Sa	BA Sa	Max/Mean	PMH Sa	Period	PMCER Sa	CY84 Sa	CB84 Sa	BSSA84 Sa	Max/Mean	DMH84 Sa	DMCER Sa	Sam	Sam
0.01	0.888	0.689	1.063	1.10	0.953	0.01	0.886	0.695	0.583	0.850	1.10	0.771	0.771	0.771	0.771
0.02	0.900	0.703	1.049	1.10	0.960	0.02	0.893	0.704	0.595	0.837	1.10	0.776	0.776	0.776	0.776
0.03	0.951	0.748	1.106	1.10	1.015	0.03	0.944	0.738	0.627	0.855	1.10	0.808	0.808	0.808	0.808
0.05	1.076	0.886	1.371	1.10	1.202	0.05	1.118	0.828	0.731	0.990	1.10	0.927	0.927	0.927	0.927
0.075	1.293	1.137	1.808	1.10	1.524	0.075	1.417	0.983	0.896	1.240	1.10	1.133	1.133	1.133	1.133
0.1	1.497	1.338	2.109	1.10	1.778	0.1	1.654	1.129	1.016	1.502	1.10	1.319	1.319	1.319	1.319
0.15	1.800	1.496	2.313	1.10	2.024	0.15	1.882	1.341	1.134	1.804	1.10	1.540	1.540	1.540	1.540
0.2	2.057	1.554	2.283	1.10	2.134	0.2	1.984	1.520	1.182	1.914	1.10	1.661	1.661	1.661	1.661
0.25	2.219	1.650	2.210	1.11	2.233	0.25	2.076	1.639	1.285	1.937	1.11	1.778	1.778	1.778	1.778
0.3	2.282	1.777	2.170	1.13	2.323	0.3	2.158	1.683	1.365	1.962	1.13	1.858	1.858	1.858	1.858
0.4	2.249	1.831	2.014	1.15	2.328	0.4	2.161	1.656	1.454	1.826	1.15	1.884	1.884	1.884	1.884
0.5	2.158	1.798	1.918	1.18	2.294	0.5	2.127	1.585	1.429	1.680	1.18	1.834	1.834	1.834	1.834
0.75	1.780	1.589	1.550	1.24	2.026	0.75	1.874	1.300	1.229	1.309	1.24	1.583	1.583	1.583	1.583
1	1.447	1.322	1.333	1.30	1.776	1	1.639	1.048	1.054	1.114	1.30	1.393	1.393	1.393	1.393
1.5	0.993	0.900	0.904	1.33	1.234	1.5	1.139	0.712	0.722	0.717	1.33	0.950	0.950	0.950	0.950
2	0.739	0.666	0.689	1.35	0.942	2	0.869	0.531	0.540	0.497	1.35	0.705	0.705	0.705	0.705
3	0.430	0.429	0.471	1.40	0.620	3	0.572	0.326	0.343	0.320	1.40	0.462	0.462	0.462	0.462
4	0.262	0.280	0.355	1.45	0.430	4	0.397	0.203	0.216	0.226	1.45	0.311	0.311	0.311	0.311
5	0.166	0.224	0.279	1.50	0.327	5	0.302	0.127	0.149	0.167	1.50	0.220	0.220	0.220	0.240
7.5	0.069	0.121	0.162	1.50	0.166	7.5	0.153	0.051	0.062	0.080	1.50	0.095	0.095	0.095	0.160
10	0.037	0.064	0.094	1.50	0.090	10	0.083	0.025	0.035	0.043	1.50	0.051	0.051	0.051	0.096

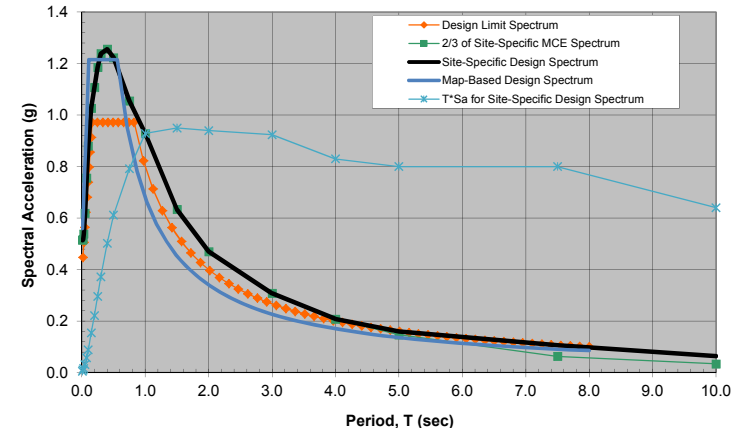
Site-Specific Spectral Response Acceleration Parameters	S _{DS}	1.131	S _{MS}	1.696	Risk Category:	II
	S _{D1}	0.950	S _{M1}	1.425	Seismic Design Category:	D

Summary of MCE Response Spectra



Map-Based Design Spectrum	Design Spectrum Limit (Sec 21.3)	2/3*Site-Specific MCE _R Spectrum	Site-Specific Design Spectrum
Period	Sa	Sa	Sa
0.01	0.551	0.424	0.514
0.02	0.616	0.460	0.517
0.03	0.682	0.495	0.538
0.05	0.812	0.566	0.618
0.075	0.975	0.655	0.755
0.1	1.138	0.743	0.879
0.15	1.215	0.921	1.027
0.2	1.215	0.972	1.107
0.25	1.215	0.972	1.185
0.3	1.215	0.972	1.239
0.4	1.215	0.972	1.256
0.5	1.215	0.972	1.223
0.75	0.907	0.972	1.055
1	0.680	0.800	0.929
1.5	0.453	0.533	0.633
2	0.340	0.400	0.470
3	0.227	0.267	0.308
4	0.170	0.200	0.207
5	0.136	0.160	0.147
7.5	0.091	0.107	0.107
10	0.054	0.064	0.064

Site-Specific Design Response Spectrum



PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE OF 2014 NGA WEST-2 GMPs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: <http://peer.berkeley.edu/ngawest2/databases/>

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable
--------	--------------------	---------------------	---------------------	-----------------	-------------------

GMPE overwriting: Geometric. Weighted average of the natural logarithm of the spectral values

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0	0.33333333	0.33333333	0.33333333	0

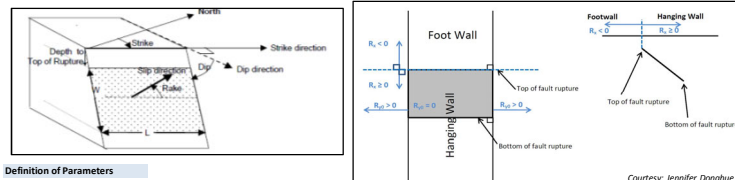
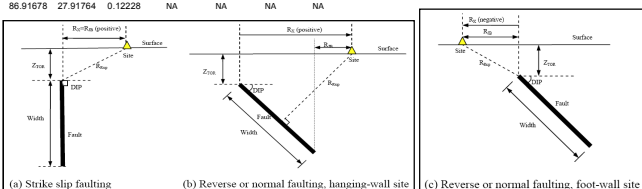
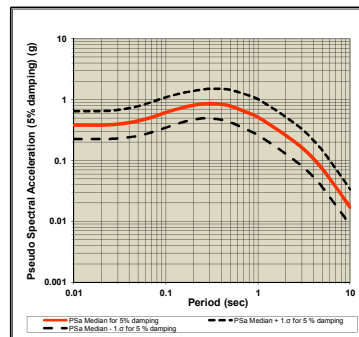
# of std. dev.	1
Damping ratio (%)	5

Modification factors are calculated in Sheet DSF

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
 BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
 CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
 CY14 Chiou & Youngs 2014 NGA West-2 Model
 I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and IMs

Input variables	Errors and warnings	T (s)	Baseline: 5% Damping					User defined: 5% Damping				
			PSa Median for 5% damping	PSa Median + 1.0 for 5% damping	PSa Median - 1.0 for 5% damping	S _a Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.0 for 5% damping	PSa Median - 1.0 for 5% damping	S _d Median for 5% damping		
M _w	6.9	0.01	0.38073	0.64356	0.22524	0.00095	0.38073	0.64356	0.22524	0.00095		
R _{rup} (km)	6.81	0.03	0.39421	0.67554	0.23004	0.00881	0.39421	0.67554	0.23004	0.00881		
R ₀ (km)	6.81	0.05	0.44463	0.77752	0.25426	0.02759	0.44463	0.77752	0.25426	0.02759		
R _x (km)	6.81	0.075	0.53088	0.94432	0.29846	0.07413	0.53195	0.94621	0.29905	0.07428		
R _y (km)	6.81	0.1	0.61417	1.09174	0.34551	0.15246	0.61601	1.09502	0.34655	0.15292		
R _{yo} (km)	999	0.15	0.73446	1.27859	0.42190	0.14022	0.73593	1.28115	0.42274	0.14104		
V ₃₃₀ (m/sec)	298	0.2	0.80451	1.38505	0.46731	0.17984	0.80612	1.38782	0.46824	0.18004		
U (BSSA13)	1: Unspecified fault mech.	0.25	0.84746	1.46115	0.49152	0.13181	0.85000	1.46553	0.49299	0.131876		
F _{rv}	1: reverse fault	0.3	0.86005	1.50405	0.49180	0.12416	0.86001	1.50555	0.49229	0.12339		
F _{rw}	1: normal fault	0.4	0.83579	1.49845	0.46618	0.31958	0.83662	1.49995	0.46664	0.32289		
F _{hw}	1: hanging wall site	0.5	0.79451	1.44316	0.42624	0.486734	0.79509	1.44460	0.42697	0.487221		
Dip (deg)	90	0.75	0.62305	1.20367	0.32250	0.89981	0.62305	1.20367	0.32250	0.89981		
Z _{top} (km)	999	1	0.51513	1.01586	0.26122	12.78751	0.51462	1.01484	0.26096	12.77473		
Z _{hyp} (km)	999	1.5	0.34815	0.69662	0.17399	19.44512	0.34849	0.69731	0.17417	19.46457		
Z _{1.8} (km)	999	2	0.25895	0.52002	0.12895	25.71265	0.25843	0.51898	0.12869	25.66122		
Z _{1.5} (km)	999	3	0.18336	0.32984	0.09091	36.49619	0.18319	0.32851	0.09082	36.45983		
W (km)	999	4	0.10738	0.21464	0.05372	42.64752	0.10727	0.21443	0.05366	42.60487		
V _{330log}	measured	5	0.07328	0.14677	0.03659	45.47716	0.07299	0.14618	0.03644	45.29525		
F _{AS}	0	7.5	0.03169	0.06311	0.01591	44.24827	0.03163	0.06299	0.01588	44.15977		
Region	California	10	0.01723	0.03379	0.00679	42.77190	0.01716	0.03366	0.00675	42.60081		



Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report

PSA = Pseudo-absolute acceleration response spectrum (g)

PGA = Peak ground acceleration (g)

PGV = Peak ground velocity (cm/s)

S_a = Relative displacement response spectrum (cm)

M_w = Moment magnitude

R_{rup} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration

R₀ = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration

R_x = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustration

R_y = The horizontal distance off the end of the rupture measured parallel to strike (km)

V₃₃₀ = The average shear-wave velocity (m/s) over a subsurface depth of 30 m

U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise

F_{rv} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust

F_{rw} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal

F_{hw} = Hanging wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise

Dip = Average dip of rupture plane (degrees)

Z_{top} = Depth to top of coseismic rupture (km)

Z_{hyp} = Hypocentral depth from the earthquake

Z_{1.8} = Depth to V_s=1 km/sec

Z_{1.5} = Depth to V_s=2.5 km/sec

W = Fault rupture width (km)

V_{330log} = 1 for measured, 0 for inferred V₃₃₀

F_{AS} = 0 for mainshock; 1 for aftershock

Region = Specific regions considered in the models. Click on Region to see codes

ADPP = Directivity term, direct point parameter; use 0 for median predictions

PGA_i (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros

Z_{top} (km) = The depth to the bottom of the seismogenic crust

Z_{rup} (km) = The depth to the bottom of the rupture plane

SS = 1 for strike slip, automatically updated in the cell

Option for S_a value: 1. Weighted average of the natural logarithm of the spectral values

DEFAULTS	USER defined	Red colored value: The value is used in the code when input is unknown			
		ASK14	BSSA14	CB14	CY14
W (km)	999.00			14.769	0.460
Z _{top} (km)	0.600	0.600			
Z _{rup} (km)	0.139		0.139		
Z _{1.8} (V _s =1100)(km)	3.210			0.398	
Z _{1.5} (V _s =1000)(km)	3.210			1.771	
Z _{hyp} (km)	999.00			10.458	
Z _{rup} (km)	0.00			0.231	0.231
Z _{top} (km)	-			15.000	

ACKNOWLEDGEMENTS



Nick Gregor, Bechtel
 Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE OF 2014 NGA WEST-2 GMPs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable
--------	--------------------	---------------------	---------------------	-----------------	-------------------

GMPE overwriting Geometric Weighted average of the natural logarithm of the spectral values

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0	0.33333333	0.33333333	0.33333333	0

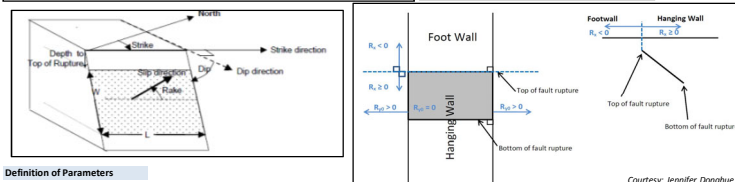
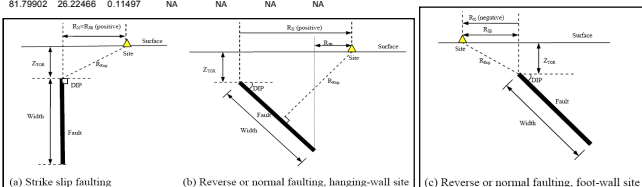
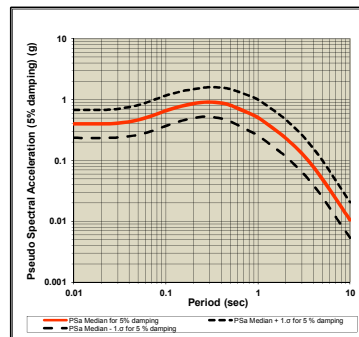
# of std. dev.	1
Damping ratio (%)	5

Modification factors are calculated in Sheet DSF

ASK14 Abrahamson & Silva & Kamal 2014 NGA West-2 Model
 BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
 CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
 CY14 Chiou & Youngs 2014 NGA West-2 Model
 I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and IMs

Input variables	Errors and warnings	T (s)	Baseline: 5% Damping					User defined: 5% Damping				
			PSa	PSa Median for 5% damping	PSa Median + 1.0 for 5% damping	PSa Median - 1.0 for 5% damping	S _a Median for 5% damping	PSa	PSa Median for 5% damping	PSa Median + 1.0 for 5% damping	PSa Median - 1.0 for 5% damping	S _a Median for 5% damping
M _w	6.6	0.01	0.39706	0.67435	0.23485	0.00099	0.39706	0.67435	0.23485	0.00099		
R _{rup} (km)	8.56	0.03	0.39866	0.67731	0.23464	0.00396	0.39866	0.67731	0.23464	0.00396		
R ₀₈ (km)	3	0.05	0.46268	0.81115	0.26391	0.02871	0.46268	0.81115	0.26391	0.02871		
R _x (km)	0.49	0.075	0.59907	0.99680	0.31356	0.07806	0.59907	0.99680	0.31356	0.07806		
R _{y0} (km)	999	0.1	0.65494	1.16697	0.30758	0.10258	0.65991	1.17047	0.30858	0.10307		
V ₃₃₀ (m/sec)	298	0.15	0.78575	1.37443	0.45019	0.43887	0.78732	1.37418	0.45109	0.43975		
U (BSSA13)	1: Unspecified fault mech.	0.2	0.85790	1.48091	0.49698	0.85185	0.85875	1.48239	0.49748	0.85270		
F _{rv}	1: reverse fault	0.25	0.90153	1.58831	0.52157	1.38871	0.90334	1.56143	0.52261	1.40151		
F _{rw}	1: normal fault	0.3	0.91359	1.60143	0.52119	2.04108	0.91450	1.60303	0.52171	2.04312		
F _{hw}	1: hanging wall site	0.4	0.87637	1.57405	0.48793	3.48076	0.87725	1.57563	0.48842	3.48424		
Dip (deg)	38	0.5	0.89801	1.48898	0.43848	5.01447	0.89882	1.49047	0.43902	5.01949		
Z _{top} (km)	8	5	0.95028	1.00770	0.02510	31.20264	0.95008	1.00300	0.02500	31.07783		
Z _{hyp} (km)	999	7.5	0.02013	0.04008	0.01010	28.10222	0.02009	0.04000	0.01008	28.04601		
Z _{1.8} (km)	0.6	10	0.01058	0.02075	0.00539	26.26238	0.01054	0.02067	0.00537	26.15733		
Z _{1.8} (km)	0.6	PGA (g)	0	0.39504	0.66872	0.23337	0.00098	0.39504	0.66872	0.23337	0.00098	
Z _{1.8} (km)	3.21	PGV (cm/s)	-1	46.31578	81.79902	26.22466	0.11497	NA	NA	NA	NA	



Definition of Parameters

- Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
- PSA = Pseudo-absolute acceleration response spectrum (g)
- PGA = Peak ground acceleration (g)
- PGV = Peak ground velocity (cm/s)
- S_a = Relative displacement response spectrum (cm)
- M_w = Moment magnitude
- R_{rup} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
- R₀₈ = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
- R_x = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustration
- R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
- V₃₃₀ = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
- U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
- F_{rv} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
- F_{rw} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
- F_{hw} = Hanging wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
- Dip = Average dip of rupture plane (degrees)
- Z_{top} = Depth to top of coseismic rupture (km)
- Z_{hyp} = Hypocentral depth from the earthquake
- Z_{1.8} = Depth to V=1 km/sec
- Z_{1.8} = Depth to V=2.5 km/sec
- W = Fault rupture width (km)
- V_{330avg} = 1 for measured, 0 for inferred V₃₃₀
- F_{AS} = 0 for mainshock; 1 for aftershock
- Region = Specific regions considered in the models. Click on Region to see codes
- ADPP = Directivity term, direct point parameter; use 0 for median predictions
- PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
- Z_{bot} (km) = The depth to the bottom of the seismogenic crust
- Z_{top} (km) = The depth to the bottom of the rupture plane
- SS = 1 for strike slip, automatically updated in the cell

Option for S_a value: 1 Weighted average of the natural logarithm of the spectral values

Input variables with defaults (if entered 999 as input):	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	999.00					
Z _{top} (km)	0.600	0.600		18.199		0.460
Z _{1.8} (km)	0.139		0.139			
Z _{1.8} (V ₃₃₀ =1100)(km)	3.210			0.398		
Z _{1.8} (V ₃₃₀)(km)	3.210			1.771		
Z _{hyp} (km)	999.00			11.252		
Z _{top} (km)	8.00			3.180		
Z _{bot} (km)	-			15.000		

ACKNOWLEDGEMENTS



Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

OpenSHA PSHA

X-Axis: Period (sec)
Y-Axis: SA (g)
Number of Data Sets: 1

DATASET #1

Name:
Num Points: 24
Info:
IMR Param List:

IMR = Chiou & Youngs (2014); Gaussian Truncation = None; Tectonic Region = Active
Shallow Crust; Component = RotD50; Std Dev Type = Total

Site Param List:

Longitude = -121.7944; Latitude = 37.7157; Vs30 = 298.0; Vs30 Type = Measured; Depth
1.0 km/sec = 600.0; Depth 2.5 km/sec = 3.21

IML/Prob Param List:

Map Type = IML@Prob; Probability = 0.02

Forecast Param List:

Eqk Rup Forecast = Mean UCERF3; Mean UCERF3 Presets = FM3.1 Branch Averaged; Apply
Aftershock Filter = false; Aleatory Mag-Area StdDev = 0.0; Background Seismicity =
Include; Treat Background Seismicity As = Point Sources; Use Quad Surfaces
(otherwise gridded) = false; Fault Grid Spacing = 1.0; Probability Model = Poisson;
Sect Upper Depth Averaging Tolerance = 100.0; Use Mean Upper Depth = true; Rup Mag
Averaging Tolerance = 1.0; Rupture Rake To Use = Def. Model Mean; Fault Model(s) =
FM3_1; Ignore Cache = false

TimeSpan Param List:

Duration = 50.0

Maximum Distance = 200.0; Pt Src Dist Corr = None

X, Y Data:

0.01	0.8875229
0.02	0.90010047
0.03	0.9511676
0.04	1.0053287
0.05	1.0758657
0.075	1.2929373
0.1	1.4972904
0.12	1.6393503
0.15	1.7997289
0.17	1.9033245
0.2	2.0568864
0.25	2.218999
0.3	2.281644
0.4	2.249194
0.5	2.1575236
0.75	1.7804508
1.0	1.4470478
1.5	0.99322253
2.0	0.7388612
3.0	0.42983487
4.0	0.26218912

OpenSHA PSHA

5.0	0.16570552
7.5	0.069231234
10.0	0.036588658

DATASET #2

Name:
Num Points: 21
Info:
IMR Param List:

IMR = Campbell & Bozorgnia (2014); Gaussian Truncation = None; Tectonic Region = Active Shallow Crust; Component = RotD50; Std Dev Type = Total

Site Param List:

Longitude = -121.7944; Latitude = 37.7157; Vs30 = 298.0; Vs30 Type = Measured; Depth 1.0 km/sec = 600.0; Depth 2.5 km/sec = 3.21

IML/Prob Param List:

Map Type = IML@Prob; Probability = 0.02

Forecast Param List:

Eqk Rup Forecast = Mean UCERF3; Mean UCERF3 Presets = FM3.1 Branch Averaged; Apply Aftershock Filter = false; Aleatory Mag-Area StdDev = 0.0; Background Seismicity = Include; Treat Background Seismicity As = Point Sources; Use Quad Surfaces (otherwise gridded) = false; Fault Grid Spacing = 1.0; Probability Model = Poisson; Sect Upper Depth Averaging Tolerance = 100.0; Use Mean Upper Depth = true; Rup Mag Averaging Tolerance = 1.0; Rupture Rake To Use = Def. Model Mean; Fault Model(s) = FM3_1; Ignore Cache = false

TimeSpan Param List:

Duration = 50.0

Maximum Distance = 200.0; Pt Src Dist Corr = None

X, Y Data:

0.01	0.68860835
0.02	0.7032603
0.03	0.7475035
0.05	0.8855165
0.075	1.1371636
0.1	1.3380638
0.15	1.495829
0.2	1.5543002
0.25	1.6495153
0.3	1.7767297
0.4	1.8307114
0.5	1.7983654
0.75	1.5889232
1.0	1.3215055
1.5	0.9002653
2.0	0.6663316
3.0	0.429117
4.0	0.27955726
5.0	0.22397813
7.5	0.12093362
10.0	0.06388538

OpenSHA PSHA

DATASET #3

Name:

Num Points: 21

Info:

IMR Param List:

IMR = Boore, Stewart, Seyhan & Atkinson (2014); Gaussian Truncation = None; Tectonic Region = Active Shallow Crust; Component = RotD50; Std Dev Type = Total

Site Param List:

Longitude = -121.7944; Latitude = 37.7157; Vs30 = 298.0; Vs30 Type = Measured; Depth 1.0 km/sec = 600.0; Depth 2.5 km/sec = 3.21

IML/Prob Param List:

Map Type = IML@Prob; Probability = 0.02

Forecast Param List:

Eqk Rup Forecast = Mean UCERF3; Mean UCERF3 Presets = FM3.1 Branch Averaged; Apply Aftershock Filter = false; Aleatory Mag-Area StdDev = 0.0; Background Seismicity = Include; Treat Background Seismicity As = Point Sources; Use Quad Surfaces (otherwise gridded) = false; Fault Grid Spacing = 1.0; Probability Model = Poisson; Sect Upper Depth Averaging Tolerance = 100.0; Use Mean Upper Depth = true; Rup Mag Averaging Tolerance = 1.0; Rupture Rake To Use = Def. Model Mean; Fault Model(s) = FM3_1; Ignore Cache = false

TimeSpan Param List:

Duration = 50.0

Maximum Distance = 200.0; Pt Src Dist Corr = None

X, Y Data:

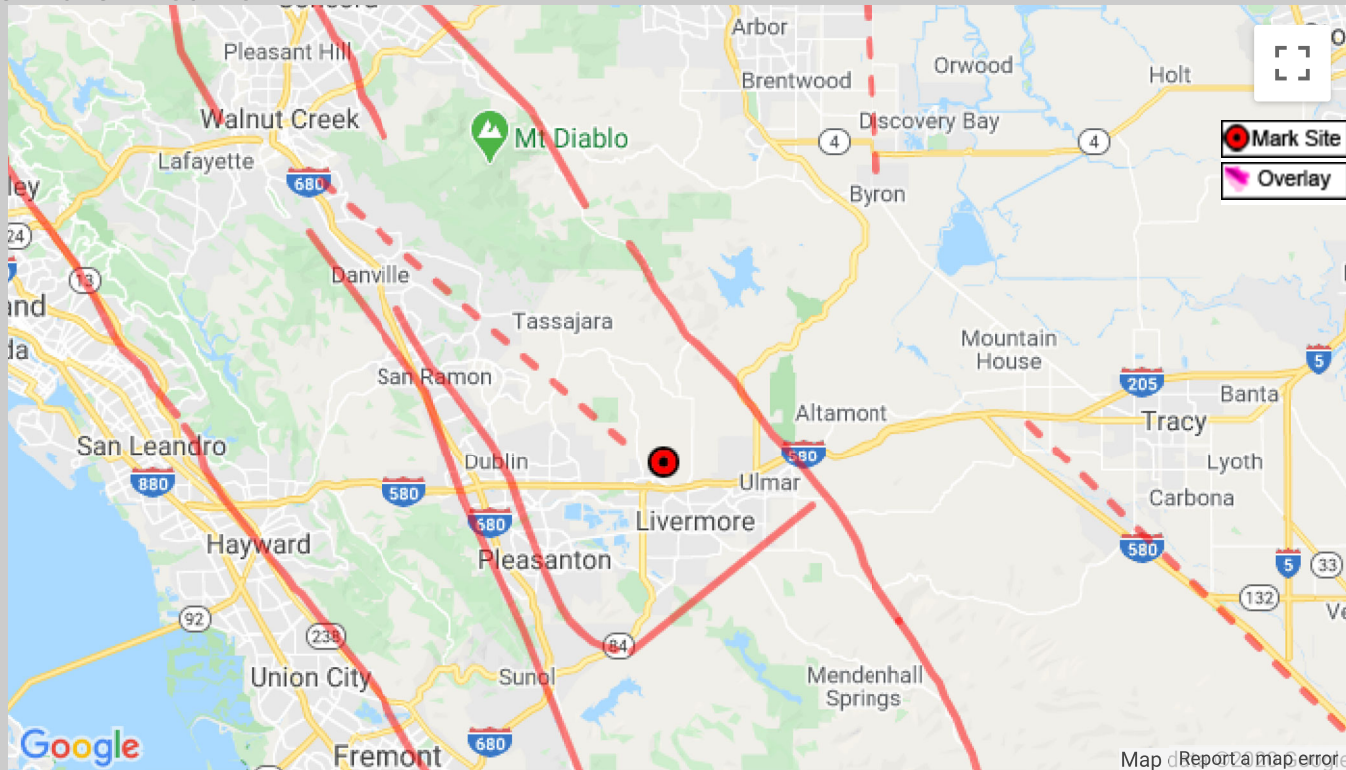
0.01	1.0629531
0.02	1.0492337
0.03	1.1061192
0.05	1.3707745
0.075	1.8084426
0.1	2.1085577
0.15	2.312939
0.2	2.2833455
0.25	2.210434
0.3	2.1704638
0.4	2.0141048
0.5	1.917998
0.75	1.5504488
1.0	1.3334035
1.5	0.90386957
2.0	0.6894234
3.0	0.47129363
4.0	0.35483468
5.0	0.27903363
7.5	0.16221902
10.0	0.093598805



Caltrans ARS Online (v2.3.09)

This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in [Appendix B of Caltrans Seismic Design Criteria](#). [More...](#)

SELECT SITE LOCATION

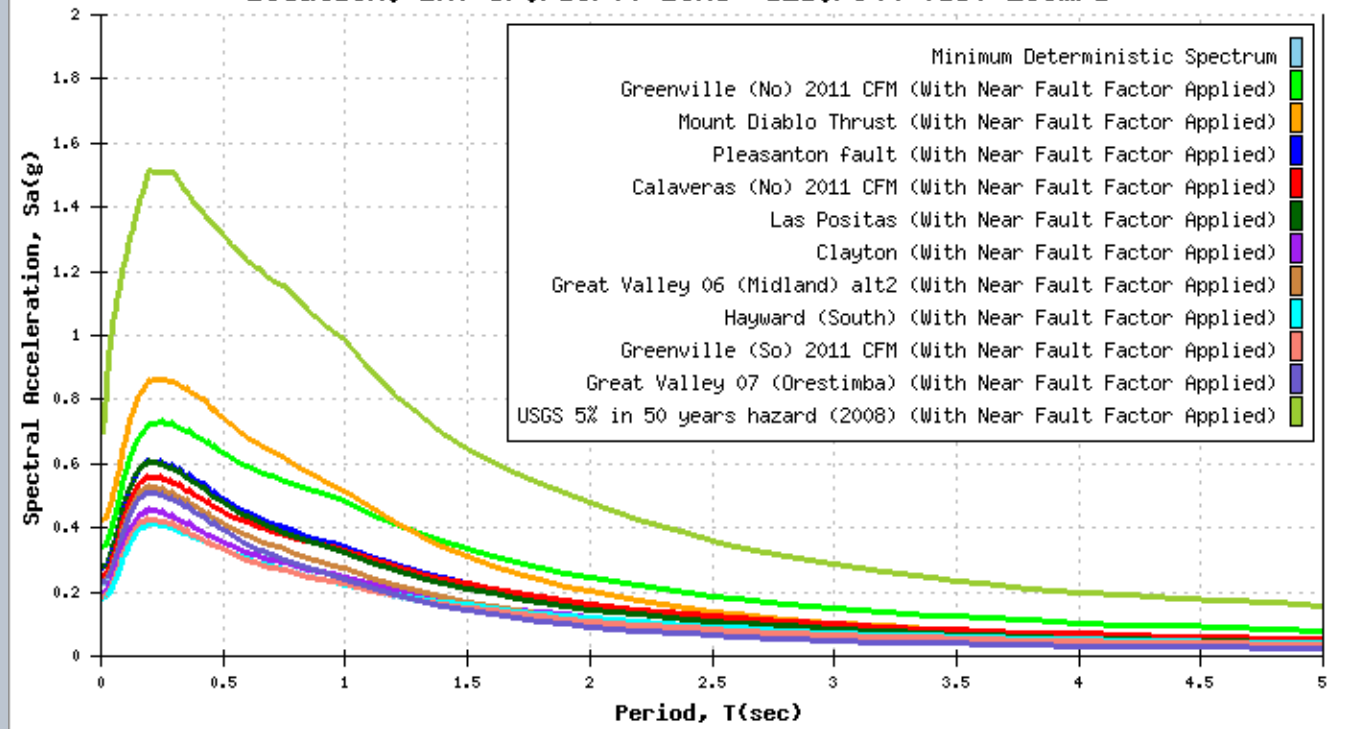


Latitude: Longitude: Vs30: m/s

CALCULATED SPECTRA

Display Curves: 10 ▾

Location: LAT=37.715700 LONG=-121.7944 Vs30=298m/s



Tabular Data

Envelope Only

Hide Near Fault

Axis Scale

Show Basin

Apply Near Fault Adjustment To:

NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

Deterministic Spectrum Using

6.81	Km Greenville (No) 2011 CFM
8.56	Km Mount Diablo Thrust
9.22	Km Pleasanton fault
12.13	Km Calaveras (No) 2011 CFM
8.28	Km Las Positas
16.80	Km Clayton
17.85	Km Great Valley 06 (Midland) alt2
22.83	Km Hayward (South)
18.33	Km Greenville (So) 2011 CFM
20.08	Km Great Valley 07 (Orestimba)

Probabilistic Spectrum Using

6.81 Km (Recommend Performing Deaggregation To Verify)

- Show Spectrum with Adjustment Only
- Show Spectrum with and without near fault Adjustment

OK



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SECTION 03 1100

CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Furnish, install and remove forms for cast-in-place concrete including shoring and form supports.
- B. Related Sections:
 - 1. Section 03 2000 Concrete Reinforcing
 - 2. Section 03 3000 Cast-in-Place Concrete
 - 3. Section 03 3500 Concrete Finishing

1.2 REFERENCES

- A. The following references, codes and standards are hereby made a part of this Section and formwork shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.
 - 1. ACI 117, 301, 318 & 347R latest editions.
 - 2. California Building Code (CBC) 2019.

1.3 QUALITY ASSURANCE

- A. Allowable Tolerances: Design, construct, set and maintain the formwork so as to insure complete work within the suggested tolerance limits specified in ACI 347-78, Section 3.3.1 and ACI 117. See Concrete Finishing Section 03 3500 for slab tolerances.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Earth Forms: Unless otherwise indicated or required by the Structural Drawings, concrete for footings may be placed directly against vertical excavated surfaces provided the material will stand without caving and provided that minimum reinforcing steel clearances indicated on Drawings are maintained and suitable provisions are taken to prevent raveling of top edges or sloughing of loose material from walls of excavation. Sides of excavation shall be made with a neat cut and the width made as detailed on Drawings. Concrete which is exposed to view on exterior shall be formed to a minimum depth of 0'-6" below finished grade.
- B. Wood Forms:
 - 1. Exposed Concrete Not Otherwise Noted or Specified: Exterior-grade plywood panels suitable for concrete forms, complying with DOC PS 1: APA HDO (high-density overlay); APA MDO (medium-density overlay), mill-release agent treated and edge sealed; APA Structural 1 Plyform, B-B or better, mill oiled and edge sealed; APA Plyform Class I, B-B or better, mill oiled and edge sealed.
 - 2. Unexposed Concrete Not Otherwise Specified: Lumber, plywood, metal, plastic, or another approved material of sufficient design and strength to hold concrete properly in place and alignment.

3. Framing: At Contractor option subject to meeting necessary strengths and surface tolerances.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Fiber tubes that produce surfaces without spiral or vertical seams:
 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Form Release Agents:
 1. Exposed Concrete Including Surfaces to Receive Paint and Other Coatings: Chemically active type producing water insoluble soaps. Form release agents shall be delivered in manufacturer's sealed and trademarked containers and shall be guaranteed to provide clean, stain-free concrete release and not to interfere with future applied coatings and finishes. Release agents shall contain no petroleum solvents such as creosote, paraffin, waxes or diesel oil.
 2. Unexposed Concrete: Contractor option except that release agents shall not interfere with bond of any applied finish.
- E. Form Ties: Contractor option except that wire ties and wood spreaders are not allowed for exposed concrete. Wood spreaders shall not remain in concrete.
- F. Chamfer Strips: Wood, metal, PVC or rubber strips, kerfed for ease of form removal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Vertical and Horizontal Controls: Establish and maintain necessary benchmarks, lines, or controls throughout construction.
- B. Secure information and provide for openings, sleeves, chases, foundation vents, pipes, recesses, nailers, anchors, ties, inserts, and similar embedded items.
- C. Coordinate with concrete work for requirements governing embedment and sleeving of pipes and conduit.

3.2 ERECTION

- A. Formwork - General: Construct wood forms of sound lumber, straight and rigid, thoroughly braced, mortar tight, and of such strength that the pressure of concrete and the movement of workers and equipment will not displace them. Visible waves in exposed concrete surfaces after stripping of forms may result in rejection of that portion of the concrete. The design and engineering of formwork shall be the complete responsibility of the Contractor.
- B. Plywood Forms for Exposed Concrete: Plywood panels shall be clean, smooth, uniform in size, and free from damaged edges or faces (including holes other than those required for form ties). Make joints plumb. Block plywood edges which do not occur at bearing points in order to eliminate joint offsets. Symmetrically align joints in forms.
- C. Framing and Bracing: Framing, bracing and supporting members shall be of ample size and strength to safely carry, without excessive deflection (exceeding allowable tolerances), all dead and live loads to which formwork may be subjected, and shall be spaced sufficiently close to prevent any apparent bulging or sagging of forms.

- D. Form Ties: Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Ties for exposed concrete surfaces shall be arranged symmetrically.
- E. Arrange forms to allow proper erection sequence and to permit form removal without damage to concrete.
- F. Form Release Agent: Thoroughly clean forms and coat with release agent prior to initial use and before each reuse. Apply release agent in strict accordance with manufacturer's directions and coverage recommendations avoiding starved areas or excessive applications. Apply release agents before reinforcing steel is placed.
- G. Prior to placement of concrete, remove dirt, debris and foreign material from forms. Leave no wood in concrete except nailers or dividers.
- H. Provide chamfer strips at all concrete edges; use 3/4 inch by 3/4 inch except as noted on drawings.

3.3 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.4 FALSEWORK

- A. Contractor shall be fully responsible for proper strength, safety and adequacy of falsework, supports and bearing surfaces therefor used on and in connection with the work. Falsework shall be designed to support imposed loads without deformation, deflection or settlement.

3.5 REMOVAL OF FORMS AND FALSEWORK

- A. The removal of forms and falsework shall be carried out in such manner as to ensure the complete safety of the structure. Do not remove forms by hammering or prying against concrete surfaces. Supports shall not be removed until members have sufficient strength to safely support their own weight and any superimposed loading with proper factor of safety.
- B. After concrete is placed, the following minimum times shall elapse before the removal of forms:
 - 1. Retaining walls: 21 days minimum.
 - 2. Footings: 7 days minimum. If backfilled immediately, side forms may be removed 24 hours after concrete is placed.
- C. Upon removal of forms, bolts, wires, clamps, rods, etc., not necessary to the work, shall be removed to a minimum of 1 inch from the surface. The Contractor shall so conduct his operations as to eliminate any danger of rust stains from form tie materials or other unprotected ferrous materials embedded in or adjacent to exposed concrete surfaces.

END OF SECTION

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SECTION 03 2000

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Furnish and install reinforcing for cast-in-place concrete work.
- B. Related Requirements:
 - 1. Concrete Forming: Section 03 1100
 - 2. Cast-in-Place Concrete: Section 03 3000

1.2 REFERENCES

- A. The following references, codes and standards are hereby made a part of this Section and all reinforcement shall conform to the applicable requirements therein except as otherwise specified herein or shown on the drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.
- B. American Concrete Institute, ACI:
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings.
 - 2. ACI 315 – Details and Detailing of Concrete Reinforcement.
- C. ANSI/AWS D1.4 – Structural Welding Code, Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute, CRSI:
 - 1. CRSI – Manual of Standard Practice.
 - 2. CRSI –Placing Reinforcing Bars.
- E. ASTM International (ASTM):
 - 1. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. ASTM A706 – Standard Specification for Low-alloy Steel Deformed Bars for Concrete Reinforcement.
- F. California Building Code (CBC) 2019.

1.3 SUBMITTALS

- A. Comply with requirements of Section 01 3300, "Submittal Procedures."
- B. Shop Drawings:
 - 1. Fully detailed shop drawings, including plans, bending schedules and bending diagrams shall be submitted to the Engineer for review. Shop drawings shall show placing details, size and location of all reinforcing steel, and lap splice and mechanical coupler locations. Detail reinforcing per planned construction joint locations.
 - 2. Shop drawing shall be of such detail and completeness that all fabrication and placement at the site can be accomplished without the use of project or contract drawings for reference.
 - 3. Contractor shall check civil, landscape, architectural, structural, mechanical, plumbing, electrical and fire protection project or contract drawings for anchor bolt schedules and locations, anchors, inserts, conduits, sleeves, and any other items which are required to

- be cast in concrete, and shall make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
4. Reinforcing steel shall not be fabricated or placed before the shop drawings have been reviewed by the Architect and returned to the Contractor. Review of shop drawings by the Architect will not relieve the Contractor of responsibility for errors or for failure in accuracy and complete placing of the work.
- C. Mill Test Reports: Certified mill test reports (tensile and bending) for each heat or melt of steel shall be submitted to the Architect before delivery of any material to the site. (See requirements above under "Source Quality Control".) Where reinforcing is required to be welded, mill test reports shall verify the weldability of the steel.

1.4 QUALITY ASSURANCE

- A. Where certified mill test reports (required hereinafter under "Submittals") are not furnished, conform to the following:
1. Reinforcing bars shall be tested in tension and bending as per ASTM A 615. Testing shall be done by the Contractor's independent testing agency. Furnish one copy of test reports to Architect, Structural Engineer, Owner and Contractor.
 2. Samples will be taken from bundles as delivered from the mill by the testing agency. Where bundles are identified by a heat number and a mill analysis accompanies to report, one tensile and one bending test specimen will be taken from each 10 tons or fraction thereof, of each size and kind of bar. Where positive identification of heat numbers cannot be made or where random samples are taken, one series of tests shall be made from each 2-1/2 tons or fraction thereof, of each size and kind of bar.
 3. The cost of tests, sampling and handling of reinforcing steel shall be paid by the Contractor.
 4. Include all material required to provide samples for testing.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver reinforcing to site properly bundled and tagged, and stored so as to prevent excessive rusting or fouling with grease or any coating that will interfere with bond. Store to avoid contact with ground. Segregate so as to maintain identification after bundles are broken. Do not use damaged, reworked, or deteriorated material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars:
1. New, free of loose rust.
 2. Deformed Steel Bars: ASTM A 615, including supplementary requirements S1. Grade 60 for all bars unless otherwise noted on drawings. Weldable (ASTM A706) where indicated or required.
- B. Welded Wire Fabric: As indicated on drawings.
- C. Tie Wire: #16 minimum, black and annealed.
- D. Reinforcement Splice Couplers: For use only where specified on the drawings. Submit other locations proposed for use to the Engineer for review. "L-series Bar Lock" Coupler Systems for Splicing Reinforcement Bars, ESR-2495, by Dayton-Superior Corporation.

- E. Accessories: Metal or plastic spacers, supports, ties, etc., as required for spacing, assembling, and supporting reinforcing in place. Legs of accessories to be of type that will rest on forms without embedding into forms. Galvanize metal items where exposed to moisture, or use approved other non-corrodible, non-staining supports.

2.2 FABRICATION

- A. Comply with details on Drawings.
- B. Where specific details are not shown or noted, do all detailing and fabrication in conformance with, or superior to, requirements contained in the References, Codes and Standards Article and ACI 315.
- C. Clean bars of loose rust, loose mill scale and any substance which may decrease bond. Bend bars cold and accurately to details on reviewed shop drawings.
- D. Shop fabricate all reinforcement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Reinforcing steel shall be placed in accord with the Drawings and viewed shop drawings and the applicable requirements of the References, Codes and Standards Article. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- B. Reinforcement Supports:
 - 1. Reinforcement shall be accurately located in the forms and held in place by means of supports adequate to prevent displacement and to maintain reinforcement at proper distance from form face. Supports and their placement shall comply with CRSI "Placing Reinforcing Bars". The use of wood supports and spacers inside the forms is not permitted except as noted in Concrete Forms Section.
 - 2. Support reinforcement for on-grade slabs by wiring to precast concrete blocks spaced 3'-0" o.c. (maximum) both ways, staggered. Size blocks so that reinforcing is maintained at the elevation shown in design drawings.
- C. Obstructions: Wherever conduit, piping, inserts, sleeves, etc., interfere with placing of reinforcing steel, obtain approval of method of procedure before any concrete is placed. Bending of bars around openings or sleeves is not permitted.
- D. Tying: All reinforcing shall be rigidly and securely tied with steel tie wire at all splices and at all crossing points and intersections in the position shown. All tie wires, after cutting, shall be bent in such a manner that concrete placement will not force the wire ends to surface of exposed concrete.
- E. Welded Wire Fabric: Fabric shall be installed in longest practical lengths and shall be wire laced at all laps. Edge laps shall be a minimum of 2" c-c of selvage wires and end laps shall be a minimum of 2" greater than transverse wire spacing. Offset all end laps in adjacent widths.

- F. Dowels: Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowels may be tied, No. 3 bars (minimum) shall be added to provide proper support and anchorage. Bending of dowels after placement of concrete will not be permitted.
- G. A minimum class B lap splice as defined by ACI 318 is required for all cases not otherwise shown on Drawings. Stagger splices wherever possible.
- H. Reinforcement Couplers: Install at all locations indicated and may be used as an alternate to lap splices in general. Install couplers in accordance with manufacturer's recommendations.
- I. Welding: Do all welding by Cadweld T series for bars #10 and larger or as noted on Drawings. No welding of reinforcing steel or of attachments to reinforcing steel will be permitted unless the chemistry of the steel conforms to AWS D12.1 and is so established by the mill certificates. If welding is to be done, all welds shall be approved by the Structural Engineer and all welding shall comply with requirements and procedures established by AWS D12.1. All welding material, wire cuttings, and tramp metal shall be thoroughly cleaned from forms for exposed concrete before any concrete is placed.
- J. Minimum covers for reinforcement:
 - 1. As shown on drawings.
- K. Lap or spliced bars shall be a minimum of 48 bar diameters in concrete, but never less than 24" or as noted on design drawings. Stagger splices in accordance with ACI 318.
- L. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier prior to placing concrete.
- M. Joints: Install so strength and appearance of concrete are not impaired at locations indicated or as approved by Architect. Continue reinforcement across construction joints unless otherwise indicated. At doweled joints install dowel bars and support assemblies where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.2 CLEANING

- A. Reinforcement, at time of placing concrete, shall be free of any coating that would impair bond.

END OF SECTION

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Furnish and install cast-in-place concrete required for the project as shown on the Drawings and specified herein. This Section also includes:
1. Concrete for work specified in Mechanical and Electrical Divisions unless specifically included therein.
 2. Grouting of bases and equipment not specified under other Sections.
 3. Coordination with other trades with regard to requirements for special bases, sleeves, chases, inserts, finishes or provisions, of any nature.
 4. Curing of formed concrete surfaces.
 5. Installation of anchor bolts, hangers, anchors, plates, inserts and miscellaneous metal or other materials embedded in concrete and which are furnished by other trades.
 6. Filling slab blockouts for columns.
- B. Related Requirements:
1. Section 03 1100, Concrete Forming (including erection, stripping and removal).
 2. Section 03 2000, Concrete Reinforcing.
 3. Section 03 3500, Concrete Finishing: Finish for concrete surfaces including patching and curing of concrete, except curing of formed concrete.
 4. Section 07 2616 Below-Grade Vapor Retarder.
 5. Division 26, Electrical: Duct encasement for underground electrical service lines, if required.
 6. Division 31 Earthwork: Aggregate base for slabs on grade.

1.2 REFERENCES

- A. The following references, codes and standards are hereby made a part of this Section and concrete work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.
- B. "Building Code Requirements for Reinforced Concrete", ACI 318.
- C. California Building Code (CBC) 2019.

1.3 QUALITY ASSURANCE

- A. Tests and inspections shall be performed by qualified individuals, engineering companies or testing laboratories who shall perform those special inspections required by CBC, those tests and inspections specified below and such other tests and inspections as the Architect or Owner may require to establish the acceptability of the work.
- B. Testing and inspection services shall be retained by the Owner at his expense except that when tests or inspections reveal failure of materials to meet the contract requirements, costs for subsequent tests and inspections will be deducted from monies due the Contractor. Excessive inspection time required by Contractor's failure to provide sufficient workmen or to properly pursue the progress of the work shall likewise be deducted.

- C. Furnish material and handling for test cylinders and any other samples which testing agency requires for analysis of concrete work. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 2000 square feet of surface area for slab or walls. Additional samples for seven day compression strength test shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.
- D. Compression Tests: 3 compression test cylinders as per ASTM C 31. One cylinder will be broken at 7 days; one at 28 days; and one cylinder retained as a spare. Cylinders will be numbered in sets (1A, 1B, 1C; 2A, 2B, 2C; etc.) and a record kept of extent of pour represented by each set and type of concrete tested. Cylinders will be broken in accordance with ASTM C 39. If any test report indicates 28-day specimen below required strength (within standard of acceptability established by ACI 318), and if required by Architect, testing agency will take test cores of hardened concrete in accordance with ASTM C 42. Such concrete shown to be defective shall be removed and replaced. Cost of core tests, repairs and removal and replacement of defective concrete shall be paid by Contractor.
- E. One (1) additional test cylinder: taken during cold weather concreting and cured on job site under same conditions as concrete it represents.
- F. One (1) slump test: taken for each set of test cylinders taken.
- G. Testing agencies will supervise preparation and selection of samples taken at job site.
- H. The following is subject to Special Inspection as per CBC. Costs therefore will be paid by the Owner.
 - 1. Taking of compression test specimens.
 - 2. Placement of reinforced structural concrete.

1.4 SUBMITTALS

- A. The General Contractor shall submit for review prior to fabrication.
- B. Limitation of Review: Structural Engineers review will be for general conformance with the design intent as indicated in the Contract Documents and does not relieve contractor of full responsibility for conformance with the Contact Documents.
- C. Product Data: Submit manufacturers' data on manufactured products and other concrete related materials such as bond breakers, cure/sealer, admixtures, etc. Demonstrate compliance with specified characteristics. Provide samples of items upon request. Submit material certificates for concrete aggregates and cementitious materials. Certificates shall show compliance to applicable ASTM's, the CBC, and additional requirements stated herein.
- D. Mix Designs: Submit Mix Designs for each structural concrete type required for work per requirements of articles MIXES and QUALITY ASSURANCE. Resubmit revised designs for review if original designs are adjusted or changed for any reason. Non-Structural mixes need not be submitted for review by Structural Engineer.
- E. Shop Drawings: Proposed location of construction and cold joints. Proposed location of all slab construction/dowel joints, control joints, and blockouts.
- F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

- G. Batch Plant Certificates: Include with delivery of each load of concrete. Provide Certificates to the Testing Agency and the Architect/Engineer as separate submittals. Concrete delivered to the site without such certificate shall be rejected and returned to the plant.
- H. Engineering Analysis: Prepared by a California-licensed Civil or Structural Engineer, justifying construction-imposed loads on slabs, beams, and walls which exceed those allowed by CBC for the specified use.
 - 1. 2000 pounds maximum allowable construction load without analysis.
 - 2. 10,000 pounds maximum allowable construction load with analysis.
- I. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.5 PROJECT CONDITIONS

- A. Cold Weather Requirements: Comply with "Recommended Practice for Cold Weather Concreting", ACI 306R, latest edition.
- B. Hot Weather Requirements: Comply with "Recommended Practice for Hot Weather Concreting", ACI 305R, latest edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: ASTM C 150, Type V, Portland Type. Cement shall be of same brand, type and source throughout project. Where aggregates are potentially reactive, use low alkali cement.
- B. Aggregates: ASTM C 33 from sources with proven history of successful use. Source shall be constant unless 10 days' prior notice is given for approval after recheck of mix design.
 - 1. Fine Aggregate: Natural sand with sand equivalent of not less than 75 when tested as per Test Method Calif. 217-E.
 - 2. Coarse Aggregate: Fine grade, sound crushed stone, natural gravel or granite with cleanness value not less than 75 when tested as per Test Method Calif. 227. Max aggregate size = 3/4 inch nominal.
- C. Water: Clean and potable, free from impurities detrimental to concrete.
- D. Admixtures: Air Entrainment Admixtures: ASTM C 260.
- E. Expansion Joint Fillers (On-Grade Slabs, Walks, Curbs, Gutters and Similar Flatwork Where Joints Are Not Otherwise Noted or Specified): ASTM D994 or ASTM D1751, asphaltic compound strips, 1/4" thick unless otherwise noted, precut to proper size.
- F. Non-Shrink Grout (Metallic): ASTM C1107/C1107M, Master Builders "Embeco 636", Sonneborn-Contech "Ferrolith G", or approved equal, premixed metallic grout.
- G. Non-Shrink Grout (Non-Metallic): ASTM C1107/C1107M, Sauereisen No. F-100, Sonneborn Contech "Fondag", Upco "Upcon", 5-Star, Master Builders "Masterflow 713", or approved equal, nonmetallic, non-staining, premixed grout having a compressive strength at 28 days of not less than 6800 psi.
- H. Curing Compounds: Comply with the requirements of Concrete Finishes Section 33 3500.

- I. Epoxy Bonding Agent: ASTM C881, Type II Grade 2 Class B or C. Do not allow epoxy to set before placing fresh concrete.
 - 1. "MasterEmaco ADH 326" (formerly "Concresive Liquid LPL") by BASF;
 - 2. "Rezi-Weld 1000" by W.R. Meadows.
- J. Chemical Hardener: Fluorosilicate solution designed for densification of cured concrete slabs "MasterKure HD 310 WB" (formerly "Lapidolith") by BASF, "LIQUI-HARD" W.R. Meadows Co, or equal.
- K. Fly Ash: Fly ash which may be used to reduce cement content shall conform to ASTM C618, Class F. Fly ash may replace up to 15 percent of cement. Submit mix design and test reports verifying compliance.

2.2 MIXES

- A. Mix and deliver concrete in accordance with ASTM C94.
- B. Provide concrete in the following strength:
 - 1. 4500 psi (28 days) normal weight (145 pcf) concrete for spread footings, grade beams, and retaining walls.
 - 2. 4500 psi normal weight (145 pcf) concrete for slab on grade.
 - 3. 4500 PSI (28 Day) normal weight (145 PCF) for concrete equipment pad and curbs.
 - 4. 4500 psi (28 day) normal weight 145 plf for miscellaneous concrete.
- C. Select admixture proportions for normal weight concrete in accordance with ACI 318.
- D. The water/cement ratio should not exceed 0.45 for concrete slabs on grade and 0.45 for all other concrete.
- E. Slump Limit: 4 inches plus or minus 1 inch.
- F. Add air entraining agent to concrete mix for work exposed to exterior.
- G. Mix designs for concrete shall be Contractor-designed at his expense. Designs shall be prepared by a qualified agency approved by the Engineer. Proposed mix designs shall be submitted for Engineer's review prior to placing any concrete and shall indicate completely, brands, types and quantities of admixtures included. If concrete is to be placed by pumping, recommendations of ACI Committee 304 shall be followed and mix designs must include strengths and slumps. Concrete mix design shall be per Section 1905A.1 of CBC.

PART 3 - EXECUTION

3.1 MIXING

- A. Concrete shall be ready mixed as per ASTM C94. Equipment shall be adequate for the purpose and kept in good mechanical condition at all times.

3.2 EXAMINATION

- A. Verification of Conditions: Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed. Do not proceed until unsatisfactory conditions have been corrected.

3.3 PLACING

- A. Absorbent forms shall be thoroughly wetted before concrete is placed. Sand base for slabs on grade shall be moist but not saturated when concrete is placed. If saturated, delay pouring of slab until sand is no longer saturated.
- B. Placing of concrete shall be done immediately after mixing. No concrete shall be placed or used after it has begun to set and no re-tempering will be allowed. The method used in placing shall be such that concrete is conveyed to place and deposited without separation of the ingredients. No concrete shall be placed with a free unconfined fall in excess of five (5) feet nor shall it be allowed to cascade through reinforcing steel in such manner as to promote segregation. Do not support runways on reinforcing steel.
- C. Splash or accumulations of hardened or partially hardened concrete shall be removed. Contact faces of forms for exposed concrete shall be protected from splash during placing of adjacent concrete. Concrete containing piping shall be placed in a manner that will prevent damage to pipes.
- D. Deposit concrete in approximate horizontal layers not exceeding 18" in thickness, unless otherwise authorized. Placing of concrete shall be carried on in a continuous operation without interruption until placing of course, section, panel or monolith is completed.
- E. Distribution of concrete shall be even and continuous and no pour joints shall show. Before a pour is started, make certain that adequate equipment, men and concrete will be available to pour in cycles which will permit proper and thorough integration of each layer of concrete. Upon stopping off a pour, the top surface shall be on a level. Points of deposit in walls shall be so spaced that it will not be necessary for concrete to flow laterally more than 24 inches.
- F. No concrete shall be placed for any element until reinforcing for same is fastened in place nor until forms are complete. No concrete shall be placed before work that is to be embedded has been set. Notify other crafts so they may deliver anchors, inserts, etc., or other work to be embedded in ample time and also notify them when their assistance in setting is required. Reinforcing or other materials that have been set in place shall not be disturbed.
- G. No pipes- except electrical conduits 1-1/4" and less in diameter shall be embedded in structural concrete. Before placing concrete, pipes and large conduits shall be sleeved providing 1/4" clearance (min.) all around Sleeves shall be positioned so as not to impair strength of surrounding elements. Sleeves and inserts will be provided and set under other sections of the work.
- H. Remove debris, mud and water from places to receive concrete.
- I. Install various inserts, anchorages, etc., required by public and private utility companies to accommodate miscellaneous metal items and equipment furnished by them.
- J. Concrete splash and/or grout shall be removed from surfaces that will receive painter's finish.
- K. Place no concrete in water unless written permission has been obtained from Structural Engineer.
- L. Maintain continuous and accurate log of placing of concrete in structure.
- M. Notify Architect and testing agency 48 hours minimum prior to placing of any concrete.

- N. Provide formed openings where required for work passing through or embedded in concrete members.
- O. Place concrete continuously between expansion joints, control joints, and construction joints.

3.4 VIBRATION AND COMPACTION

- A. Concrete shall be thoroughly compacted by means of internal mechanical vibrators. Such compaction shall be produced as will be obtained by placing the vibrator directly in concrete at 18"-30" intervals for a period of approximately 5 to 15 seconds and withdrawing slowly or as directed, depending on the consistency of concrete. One vibrator will be required for each location where simultaneous placing takes place, to ensure thorough vibrating of all sections. Provide sufficient spare vibrators on the job so as to have them readily available in case any vibrator in use should suddenly cease to function properly. Where spare vibrators are employed, provide additional spares. Under no condition shall vibrator be placed against reinforcing steel or attached to forms. Use no vibrators to transport material.
- B. Special care shall be taken to prevent voids under column baseplates; especially at keyway blockouts for shear lugs. Provide pour holes in anchor bolt templates as required.
- C. Vibrator shall be of the flexible immersion type having a frequency of not less than 7,000 rpm.
- D. Voids and rock pockets shall be eliminated.

3.5 CONSTRUCTION JOINTS

- A. Placement of construction joints and the manner in which they are provided for shall be only as approved by Architect or as shown on the Drawings. Construction joints shall be as few as possible and will not be permitted simply to save forms. Submit shop drawings of construction joints showing proposed locations and details. Submit to Architect prior to forming or placing concrete.
- B. Under no condition will construction joints be permitted in exposed concrete surfaces other than where specifically shown and specified.
- C. Construction joints including keys shall be cleaned and roughened by removing entire surface and exposing clean aggregate solidly embedded by means of sandblasting or other approved methods. Forms and reinforcing shall be cleaned of drippings, debris, etc. Just before starting of new pour, horizontal surfaces shall be covered with 1/2"-1" thickness of grout composed of cement and fine aggregate of the same proportion as that used in concrete work, but omitting the 1-1/2" aggregate where 1-1/2" is the maximum size, or 1/2 of the 3/4" aggregate where 3/4" is the maximum size. Proportions will be determined by the testing agency.
- D. Saw-Cut Weakened Plane Joints: Saw after the concrete has been finished with an early-entry dry-cut saw. Joint depth shall be 1/4 of slab depth but no less than 1 inch. Saw-cut joints shall be installed as soon as the concrete is sufficiently hard to resist tearing and raveling and before random cracking occurs, but no more than 4 hours after finishing.

3.6 CURING

- A. Formed Concrete: Keep formed concrete surfaces continuously wet both in forms and after removal of forms for at least seven (7) days after placing. Wood forms shall be kept wet. If forms are permitted to be removed prior to expiration of curing period, exposed concrete

surfaces shall be kept continuously wet. Application of curing compounds shall conform to requirements of Concrete Finishes Section.

- B. Epoxy Area: Concrete should be either water cured or cured using sodium silicate curing compounds only. Concrete should be cured for a minimum of 28 days before installing epoxy.

3.7 EQUIPMENT BASES

- A. Verify sizes and shapes required by items specified elsewhere. Concrete bases for special equipment shall be installed in strict accord with Drawing details and the specifications and recommendations of the equipment manufacturer.

3.8 EXPANSION JOINT FILLERS

- A. Asphaltic Filler Joints: Place filler material so that top of surface is level and aligned uniformly 1/4" below adjacent concrete surface. Provide where slabs abut vertical surfaces, at not over 24 feet centers horizontally in paving and at other locations so noted on Drawings. Follow Drawings for pattern where indicated; where not indicated, coordinate locations with Architect before proceeding.

3.9 GROUTING

- A. Grout shall be metallic or non-metallic, non-shrink grout mixed and applied in strict accordance with manufacturer's directions, except use non-metallic only where grouting is exposed in the finished work.

3.10 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Architect.

END OF SECTION

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SECTION 03 3500
CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Finishing required on exposed cast-in-place concrete surfaces including patching and curing of cast-in-place concrete.
- B. Related Requirements:
 - 1. Section 03 3000, Cast-In-Place Concrete.
 - 2. Section 07 9200, Joint Sealants.
 - 3. Pertinent Sections of Division 09 specifying concrete floor preparation for applied finishes.

1.2 SUBMITTALS

- A. See Section 01 3300 – Submittals, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Curing Materials:
 - 1. Curing Paper: ASTM C171, non-staining waterproof paper, regular type.
 - 2. Curing Compounds: ASTM C309, Type 1, clear resin type free of oil, wax grease, or other substance which might prove deleterious to any material to be applied to concrete. Curing compounds for exposed class shall be a multi-purpose curing-hardener-sealer type equivalent to Curecrete Distribution Inc., Ashford Formula.
- B. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Products:
 - a. Curecrete Distribution Inc.; Ashford Formula: www.ashfordformula.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Performance Requirements:
 - a. Volatile Organic Content: 0 g/l.
 - b. Abrasion resistance (ASTM C779): At least 32.5% increase at 30 minutes.
 - c. Curing: At least 93% greater moisture retention during the initial critical 24 hour curing period compared to untreated samples.
 - d. Compressive strength (ASTM C39):
 - 1) At least 40 percent increase in compressive strength at 7 days compared to untreated samples.
 - 2) At least 38 percent increase at 28 days compared to untreated samples.
 - e. Impact resistance (ASTM C805): At least 13.3 percent increase in impact resistance compared to untreated samples.

- f. Permeability 0.00073 oz (0.022 cc) / hour seepage rate using a 7'-0" (2.13 m) head of water and a 4.91 in² treated area.
- g. Coefficient of Friction (ASTM C1028): 0.86 dry, 0.69 wet.

PART 3 - EXECUTION

3.1 CURING

- A. Cure concrete by use of curing paper or curing compounds, as specified herein and in accordance with ACI 308.
- B. Do not use curing compounds on surfaces when their use may be detrimental to bonding of concrete, joint sealants or the specified surface finish or coating. Use curing-hardener-sealer type compounds for exposed slabs.
- C. Curing Compound - General:
 1. Apply immediately following completion of specified finishing.
 2. When applying compound, the surfaces shall be damp but free from standing water.
 3. Cover surfaces with a uniform and even film of compound, as supplied. Using pressurized spray equipment, apply in a single coat to achieve total coverage as recommended by manufacturer.
 4. When curing compound is applied inside enclosed spaces, provide and maintain adequate ventilation throughout the periods of application.
- D. Paper Curing: Concrete not otherwise permitted to be cured by curing compound shall be paper cured as follows:
 1. Saturate slabs such that free moisture occurs over the entire area.
 2. After dampening, immediately cover slabs with curing paper lapped 4 inches at joints and sealed with adhesive tape or waterproof glue. Curing paper shall remain in place for not less than 10 calendar days. During curing period, scuffed or torn areas must be promptly recovered with additional papers. Do not use curing papers, which contain a distinct thread design that may leave an impressed pattern on the slab.
- E. Vapor Control: Apply below grade vapor retarder in accordance with Section 07 2616, "Below Grade Vapor Retarder."
- F. Hardener: Apply materials according to manufacturer Instructions.

3.2 FINISHING

- A. Flatwork:
 1. Unless otherwise noted or specified, all slabs shall be finished monolithically. Floor slabs, which are indicated as sloped to floor drains, shall be sloped uniformly so as to provide positive drainage of the indicated areas. Special care shall be taken that a smooth, even joint is obtained between successive pours.
 2. Tolerances:
 - a. Exposed concrete slabs and slabs to receive carpet: 1/8 inch in 8 feet with maximum high and low variance not occurring in less than 16 feet and with 1/16 inch tolerance in any one running foot with no abrupt variations.
 - b. Slabs to receive resilient flooring: 1/8 inch in 10 feet with maximum high and low variance not occurring in less than 20 feet, and with 1/16 inch tolerance in any one running foot with no abrupt variations.
 - c. Slabs to receive tile set with dry-set mortar: 1/4 inch in 10 feet.

3. Trowel Finish (Typical for exposed interior slabs and under carpeting, resilient flooring, and all other areas not specifically noted): After the concrete slab has been screeded to finish grade and float finished, the floating shall be followed by steel troweling after the concrete has hardened sufficiently to prevent excess fine material from working to the surface. Jitterbugs shall not be used where slabs are exposed. The finish shall be brought to a smooth uniform surface free from defects and blemishes. No dry cement or mixture of dry cement and sand shall be sprinkled on the surface.
4. Broom Finish (Typical for exterior flatwork unless noted otherwise): After screeding and floating, the concrete slab shall be given a light steel troweling to seal the surface and remove any irregularities left by the wood float. Just before the concrete becomes non-plastic, the surface of the concrete shall be given a broom finish with a broom not less than 18 inches wide. The broom shall be pulled gently over the surface of the concrete from edge to edge. Adjacent strokes shall be slightly overlapped. Unless direction of brooming is indicated on Drawings, brooming shall be perpendicular to the line of traffic and so executed that the corrugations thus produced will be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface. See Division 02 for Site Concrete and broom finishes at all accessible paths of travel.
5. The surface of exterior concrete slabs and walks shall be scored as shown on Drawings or as directed by Architect using a tool which will produce a groove 1/4 inch wide at top and a depth of 1/2 inch with rounded corners. All lines shall be straight, parallel, and/or square, all intersections square cut. Edges of slabs shall be rounded in the same manner.
6. Special concrete exterior slab finishes. See Drawings.

B. Curbs:

1. Top surfaces of curbs shall be steel trowel finished as specified for slabs, edges tooled.
2. Face forms shall be removed as soon as concrete has set sufficiently to retain shape. Vertical surfaces exposed in the finish work shall be plastered with cement grout where necessary and troweled smooth.

3.3 REPAIR/RESTORATION

- A. Defective Work: Finish which is not true to line and plane, which is not in conformance with specified finish and appearance requirements, which exceeds specified tolerances, which does not properly connect to adjoining work, which does not slope to drain and which has been improperly cured, will be deemed as defective. All such defective work shall be removed and replaced with proper work meeting Drawing and Specification requirements and at no added cost to the Owner.
- B. Patching: Within 3 days after stripping formwork, surface defects such as rock pockets, honeycombs, cracks, and holes shall be filled and patched. The Architect shall distinguish between concrete, which requires replacement or repair and surface defects, which require patching. Permission to patch an area shall not be construed as a waiver of the Architect's right to require complete removal of the defective work if the patching, in his opinion, does not satisfactorily restore the quality and appearance of the surface.
 1. At areas to be patched, chip away loose material and thoroughly wet area to at least 6 inches entirely surrounding the patch area. Coat areas with thin brush coat of fine sand-cement grout followed by patching mortar. Prepare patching mortar of the same material and proportions as used for concrete, except remove coarse aggregate. Keep water in the mix to a minimum. Do not re-temper mortar by adding water. Allow mortar to stand for one-hour prior to use and mix thoroughly to prevent setting. Thoroughly compact mortar into place and screed to leave patch slightly higher than surrounding surfaces and then leave undisturbed for 1 to 2 hours to permit initial shrinkage. Finish patch to match adjacent surface.

2. Solidly fill form tie holes with patching mortar as specified above and finish to match adjacent surface.

3.4 PROTECTION

- A. Contractor shall employ security forces to protect all concrete finishes during curing.
- B. Protect exposed surfaces including flat work as required to prevent damage by impact or stains from rubbish and the work of other trades. Employ security personnel for the protection of flatwork during curing.

END OF SECTION

SECTION 03 5415

PORTLAND CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Liquid-applied, high-strength, fast-setting, non-shrink cement underlayment for patching, filling, and leveling floors to meet requirements of applied floor finish.
- B. Related Requirements:
 - 1. Concrete Moisture Testing: Section 01 4520.
 - 2. Finishes: Division 09; applied floor coverings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's literature describing materials and specifications for mixing, placing, curing, and protecting.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of applicator qualifications for self-leveling underlayment if used on the Project.

1.5 QUALITY ASSURANCE

- A. Mockups: Provide underlayment as required for mockups specified for applied floor coverings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements specified in Section 01 6100, "Materials and Equipment."

1.7 FIELD CONDITIONS

- A. Environmental Requirements:
 - 1. Spaces to receive underlayment shall be maintained at a temperature above 40 degrees F before and during installation.
 - 2. During the curing process, ventilate spaces to remove excess moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Portland Cement Underlayments: Ardex Inc. as specified and the basis of design, Raeco by Silpro LLC Inc., Thoro System products, or equal.

2.2 MATERIALS

- A. General: Materials listed below are not necessarily all-inclusive, nor are all materials listed necessarily required to be used.
- B. Self-Leveling Underlayment: Non-structural, premixed blend of cement, graded aggregate, polymers, and control additives capable of being installed to feather edge; Ardex K 10" in pre-blended bag, or accepted equal with a compressive strength not less than 4,500 psi at 28 days.
- C. Floor Patching Filler: "Ardex Feather Finish" for non-moving cracks and joints.
- D. Primers, Unless Otherwise Recommended by Manufacturer for Field Conditions:
 - 1. Absorbent Concrete: "Ardex P 51 Primer.
 - 2. Non-Porous Substrates: "Ardex P 82 Ultra Prime."
- E. Water: Clean and potable, free from impurities detrimental to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate, and verify that surfaces are free from debris, oil, grease, wax, curing compounds, and dust and are reasonably clean and dry and that conditions are otherwise suitable to receive underlayment.

3.2 PLACING OVER CONCRETE

- A. Follow manufacturer's technical bulletins for application of each product.
- B. Do not exceed thickness recommended by manufacturer for mix without aggregate or supplemental reinforcing.
- C. Select proper primer for condition of substrate, mix, and apply with rubber squeegee over entire surface to receive underlayment.
- D. Pour or pump concrete compound, as applicable to selected product, in accordance with manufacturer's printed instructions.
- E. Use self-leveling underlayment where necessary to bring large areas of existing concrete substrate into levelness and flatness tolerances required for application of applied floor coverings. Install in one pour from feather edge spreading and screeding to a smooth surface.
- F. Finish shall be as recommended by manufacturer for reception of specified finish materials.

3.3 CURING

- A. Allow underlayment to harden as recommended by manufacturer.
- B. Do not allow traffic on underlayment during hardening period; minimum 2 hours or longer if special conditions exist.
 - 1. Do not load floors until reasonable strength has been achieved.
 - 2. Any loading on topping shall be distributed and not concentrated.
- C. Maintain adequate ventilation and temperature above 50 degrees F until underlayment is dry.

3.4 ADJUSTMENT

- A. Underlayment is subject to moisture testing as specified in respective floor finish Section.
- B. Repair defects, evident after curing, that make underlayment an unacceptable substrate for finish flooring. Use materials recommended by underlayment manufacturer.
 - 1. Fill dimples.
 - 2. Sand down protrusions smooth and flush with adjacent surface.
- C. Repair underlayment damaged after installation prior to installation of scheduled floor finish.

END OF SECTION

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SECTION 04 2200

REINFORCED UNIT MASONRY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Reinforced concrete unit masonry including:
 - 1. Concrete masonry units.
 - 2. Mortar and grout
 - 3. Steel reinforcement and tie wires.
 - 4. Accessory Items.
- B. Related Requirements:
 - 1. Concrete Reinforcing: Section 03 2000.
 - 2. Cast-In-Place Concrete: Section 03 3000.
 - 3. Portland Cement Plastering: Section 09 2400.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
 - 2. ASTM A653 – Steel Sheet, Zinc Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM C90 – Load-Bearing Concrete Masonry Units.
 - 4. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 5. ASTM C129 – Non-Load Bearing Concrete Masonry Units.
 - 6. ASTM C140 – Sampling and Testing Concrete Masonry Units.
 - 7. ASTM C144 – Aggregate for Masonry Mortar.
 - 8. ASTM C150 – Portland Cement.
 - 9. ASTM C-207 – Hydraulic Lime
 - 10. ASTM C404 – Aggregate for Masonry Grout.
- B. MSJC (Masonry Standards Joint Committee) Code – ACI (American Concrete Institute) 530/ASCE (American Society of Civil Engineers) 5/TMS (The Masonry Society) 402 – Building Code Requirements for Masonry Structures.
- C. MSJC (Masonry Standards Joint Committee) Specification – ACI (American Concrete Institute) 530.1/ASCE (American Society of Civil Engineers) 6/TMS (The Masonry Society) 602 – Specifications For Masonry Structures.

1.3 SUBMITTALS

- A. Shop Drawings indicating bar sizes, spacing and locations of reinforcing steel, bending and cutting schedules, and supporting and spacing devices.
- B. Certified Mix Design for grout and mortar: Include results of testing or test data used to establish mix proportions for grout.
- C. Concrete Masonry Units: Data on material properties.
- D. Samples only as requested by Testing Laboratory or Architect.

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: The masonry work shall comply with the requirements of this section and, in addition, shall conform to the applicable requirements of the 2019 CBC, Chapter 21A.
1. Materials:
 - a. Masonry Units.
 - b. Portland Cement, Lime.
 - c. Mortar and Grout Aggregates.
 - d. Steel Reinforcement.
 2. Quality:
 - a. Portland Cement Tests.
 - b. Mortar and Grout Tests.
 - c. Masonry Prism Tests.
 - d. Masonry Unit Tests.
 3. Inspection:
 - a. Masonry Inspection.
 - b. Reinforcing Bar Welding.
- B. References and Standards:
1. American Concrete Institute (ACI)
 2. American Society for Testing and Materials (ASTM)

1.5 TESTS AND INSPECTIONS

- A. Tests requested by the Architect shall be made by a testing laboratory employed and paid for by the Owner. Any masonry work failing to meet required design stresses as specified hereinafter shall be dismantled and replaced at no extra cost to the Owner.
1. Tests requested by the Contractor to establish design stresses when tests made by the Testing Laboratory indicate defective masonry shall be paid for by the Contractor.
- B. Inspection: Approval of the reinforcing steel after installation must be received from Architect. Architect shall be notified at least 48 hours in advance of the beginning of grouting operations.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Unload masonry units carefully and store on raised platform protected from weather.
- B. Protect cementitious materials against exposure to moisture. Use of cementitious or other materials that have become caked and hardened from absorption of moisture will not be permitted.

1.7 JOB AND ENVIRONMENTAL CONDITIONS

- A. Environmental:
1. Cold Weather conditions: Do not place unit masonry when temperature is below 40°F unless Architect approves and Contractor provides means for preventing damage from freezing before and after placement.
 2. Hot Weather conditions: Protect masonry construction from direct exposure to wind and sun when erected; with an ambient air temperature of 99°F in the shade with relative humidity less than 50%.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basalite Block Company, Inc.
- B. Best Block Company.
- C. Or equal.

2.2 CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Units: ASTM C90, Grade N, Type I: Medium Weight. Units shall be of the following types:
 - 1. Standard 8" x 8" x 16" smooth faces, as indicated on drawings; Architect to select color from manufacturer's standard colors. Compressive strength = 2000 psi.
 - 2. Provide open and closed-end units, bond beams, U beams, half units and any additional special shapes and sizes as required to complete the Work.
- B. Color / Surface Texture: See Architectural Drawings.
- C. Course: as indicated.

2.3 MORTAR AND GROUT

- A. Portland Cement: ASTM C150, Type I or II. Masonry cement will not be permitted.
- B. Aggregate:
 - 1. For mortar: ASTM C144.
 - 2. For grout: ASTM C404.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Quick Lime: In accordance with CBC.
- E. Water: Clean and potable, free from impurities detrimental to mortar and grout.
- F. Admixtures:
 - 1. Only with Architect's approval and not adversely affecting bond or compressive strength.
 - 2. Admixture, Grout Additive: All grout shall contain "Grout Aid" as manufactured by Sika Chemical Corporation or "Pre-Mix Products Grout Additive" as manufactured by Valley Abrasive Shot, Inc. Mix Grout Additive as recommended by the manufacturer.
- G. Mortar Color: See Architectural Drawings

2.4 REINFORCEMENT.

- A. Reinforcing Steel: Same type and quality specified for concrete reinforcing, Section 03 2000.
- B. Wire Ties: No. 16 annealed wire for tying reinforcing steel.

2.5 ACCESSORIES AND RELATED ITEMS

- A. Bonding Agent: Concessive #1001-LPL (1-1/2 hour maximum pot life), an epoxy polysulfide type concrete adhesive as manufactured by Adhesive Engineering, San Carlos, California; or approved substitute.
- B. Control Joints: Preformed rubber in profiles required or shown. Same as Dur-O-Wal Inc.'s "Rapid Control Joint"; or approved substitute.
- C. Wire Joint Reinforcement: Hot-dip galvanized, 9 gauge continuous wire in joint in accordance with CBC.

2.6 MIXES AND MIXING

- A. Mortar:
 - 1. Meet the requirements of CBC for Type S Mortar.
 - a. Compressive Strength: 1,800 psi at 28 days.
 - b. Proportions by volume: One part Portland cement, 2.25 to 3 parts, and not less than a quarter nor more than half part lime.
 - 2. Mortar shall be mixed as follows, with a total mixing time not less than ten minutes.
 - a. Place approximately half of required water and sand into mixer while running.
 - b. Add cement and remainder of sand and water into mixer in that order and mix for a period of at least two minutes.
 - c. Add lime and continue mixing as long as needed to secure a uniform mass.
 - 3. Use and place mortar in final position within 2-1/2 hours after mixing. Mortars that have stiffened due to evaporation of water may be re-tempered with water as necessary to restore required consistency during that time period.
- B. Grout:
 - 1. Grout shall comply with Article 2.2 of TMS 602/ACI 530.1/ASCE 6.
 - a. Compressive strength: 2000 psi at 28 days.
 - b. Water: Water content shall be adjusted to provide proper workability and to enable proper placement under existing field conditions, without segregation.
 - c. Proportions by volume: One part Portland cement, 3 parts sand, 2 parts pea gravel, and sufficient water to cause the grout to flow into joints without segregation..

2.7 SOURCE QUALITY CONTROL

- A. Owner's Testing Agency will:
 - 1. Review mix designs for mortar and grout.
 - 2. Review certificates of compliance for materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive masonry and verify following:
 - 1. That foundation surface is level to permit bed joint with range of 1/4" to 3/4".
 - 2. That edge is true to line to permit protection of masonry to less than 1/4".
 - 3. That projecting dowels are free from loose scale, dirt, concrete, or other bond-inhibiting substances and properly located.
- B. Do not begin work before unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean concrete surfaces to receive masonry. Remove laitance or other foreign material lodged in surfaces by sandblasting or other means as required.
- B. Ensure masonry units are clean and free from dust, dirt or other foreign materials before laying.
- C. Establish lines, levels and coursing. Protect from disturbances.
- D. Provide temporary bracing during erection of masonry work. Maintain in place until masonry has set to provide permanent bracing.

3.3 COURSING

- A. Erect unit masonry in accordance with 2019 CBC, Chapter 21A.
- B. Place unit masonry to lines and levels indicated to the following tolerances:
 - 1. Variation from unit to adjacent unit: 1/32" maximum.
 - 2. Variation from plane to wall: 1/4" in 10'.
 - 3. Variation from plumb: 1/4".
 - 4. Variation from level coursing: 1/8" in 3'; 1/4" in 10'; 1/2" maximum.
 - 5. Variation of joint thickness: 1/8" in 3'. (max joint thickness: 1/2").
- C. Bond: Use running bond typical unless otherwise noted. Lay concrete masonry units with vertical joints located at center of unit in course below.
- D. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
- E. Preserve the vertical continuity of cells in concrete unit masonry. The minimum clear horizontal dimensions of vertical cores shall be 3" x 3" for an 8" wide block.

3.4 PLACING AND BONDING

- A. Do not install cracked, broken or chipped concrete masonry units.
- B. Lay only dry concrete masonry units.
- C. Shape blocks where required for fit up by saw cut.
- D. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints, are not permitted.
- E. Full bond intersections and external and internal corners.
- F. Do not shift or tap concrete masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
- G. Remove excess mortar.
- H. Perform jobsite cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.

3.5 JOINTS

- A. Horizontal and Vertical Joints at brick masonry units shall be as specified herein and concrete unit masonry construction shall be 3/8" wide and as follows:
 - 1. Point joint tight in masonry below ground.
 - 2. All end joints shall be fully filled with mortar and joints squeezed tight. Slushing of mortar into joints shall not be permitted. Mortar in bed joints shall be held back approximately 1/2 inch from cell to provide positive bond with grout.
 - 3. Exposed joints:
 - a. At all interior exposed surfaces of concrete masonry units, vertical and horizontal joints shall be flush.
 - b. At all exterior surfaces of concrete masonry units, vertical and horizontal joints shall be concave.
 - 4. Concave joints shall be formed by striking the mortar flush, and after partial set tooled with a 20" long tool to provide a uniform joint, free of waves. Tool shall be of a diameter to provide a joint that is as close to flush as possible.

3.6 MASONRY REINFORCEMENT

- A. Place reinforcement in accordance with ACI 315, to a tolerance of plus or minus 1/2 inch from specified location.
- B. Reinforcing Steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of bars for bending will not be permitted.
 - 1. Bars shall conform accurately to the sizes, shapes, lines and dimensions shown on drawings and with hooks and bends made as detailed. Bars shall be placed as indicated on the drawings and centered on grout space.
 - 2. At the time grout is placed around it, reinforcing steel shall be clean of mill scale or other coatings that will destroy or reduce bond.
 - 3. All vertical reinforcing steel shall be installed in one piece, full height of wall, and braced throughout its height in a manner that will retain the steel in proper position and provide the proper clearance.

3.7 GROUTING

- A. General Requirements:
 - 1. All cells with or without reinforcing shall be grouted solid.
 - 2. Use low lift grouting. Grout pours shall not exceed 4 feet in height.
 - 3. Use grout pump, hopper or bucket to place grout.
 - 4. Place grout in final position within 1-1/2 hours after introduction of mixing water.
 - 5. Place grout and rod with a 3/4 inch flexible cable vibrator sufficiently to cause it to flow into all voids between the cells and around the reinforcing steel. Slushing with mortar will not be permitted.
 - a. Do not insert vibrators into lower pours that are in a semi-solidified state.
 - 6. Stop grout approximately 1-1/2 inches below top of last course; except at top course bring grout to top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below the top of the masonry.
- B. Prior to grouting, the grout space shall be clean so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material.
- C. The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.

3.8 CONTROL JOINTS

- A. Install resilient control joints in continuous lengths as shown on Drawings.
- B. Size joints in accordance with manufacturer's recommendations for sealant performance.

3.9 BOND BEAMS

- A. Bond beams shall be located where shown and detailed on the Drawings, and shall be reinforced as indicated and as hereinafter specified.

3.10 BUILT-IN WORK

- A. Miscellaneous Embedded Items: All items indicated to be embedded in masonry shall be carefully located and anchored to prevent movement during grouting operations. Avoid cutting and patching.
 - 1. Install all anchor bolts and anchors furnished under other Sections.

3.11 CUTTING AND FITTING

- A. Cut and fit for weep holes pipes and miscellaneous penetrations. Cooperate with other Sections' work to provide correct size, shape and location.
- B. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

3.12 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units.
- B. Pointing: During the tooling of joints, enlarge any voids or holes and completely fill with mortar.
- C. Dry brush masonry surface after mortar has set, at end of each day's work and after final pointing.
- D. Leave work and surrounding surface clean and free of mortar spots and droppings.
- E. Cleaning: Upon completion of masonry installation, repair all holes. Defective joints shall be cut out and rejoined. Exposed masonry surfaces shall be cleaned free of mortar, green stain and efflorescence.

3.13 FIELD QUALITY CONTROL

- A. The Owner's Inspector and/or Testing Agency will:
 - 1. Provide the following checks as a minimum:
 - a. Measurement and mixing of field mixed mortar and grout.
 - b. Moisture conditions of masonry units at time of laying.
 - c. Observation of laying of units with special attention to joints and bonding of units at corners.
 - d. Proper placement of reinforcement including splices, clearances and supports.
 - e. Observation of placement of pipes, conduits, or other weakening elements.
 - f. Inspection of grout spaces immediately prior to grouting for removal of mortar fins, dirt and debris.

- g. Continuous observation of grout placement with attention to procedures to avoid segregation and achieve proper consolidation.
 - h. Perform or supervise sampling for testing.
- B. The Contractor shall be responsible for repair of any damage to work caused by testing.
- C. The Contractor shall pay the Owner's Testing Agency for all additional testing required, including masonry cores, when laboratory tests of specimens show compressive strengths below specified minimum and judged to be inadequate by Architect.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Structural Steel as indicated on Structural Drawings. This section also includes anchor bolts.

1.2 REFERENCES

- A. Comply with applicable provisions of the following; latest editions unless otherwise specified.
 - 1. American Institute of Steel Construction, AISC:
 - a. 341, Seismic Provisions for Structural Steel Buildings.
 - b. 358, Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
 - c. 360, Specification for Structural Steel Buildings.
 - d. 303, Code of Standard Practice for Steel Buildings and Bridges. Delete the following sentence from paragraph 4.2.1: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."
 - 2. American Welding Society, AWS: D1.8, Structural Welding Code: Steel.
 - 3. Research Council on Riveted and Bolted Structural Joints: Specifications for Structural Joints using ASTM A-325 or A-490 Bolts.
 - 4. California Building Code, CBC, 2019 Edition with Amendments.
 - 5. Steel Structure Painting Council, SSPC: Surface Preparation Specifications.

1.3 DEFINITIONS

- A. Seismic-Load Resisting System: elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- B. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and non-structural elements to protected zones are limited.
- C. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.4 SUBMITTALS

- A. Conform with requirements of Section 01 3300, "Submittal Procedures."
- B. Shop Drawings: Show fabrication, assembly, and erection details, sizes of members, fastenings, supports and anchors, patterns, clearances, and necessary connections to work of other trades. Identify members and connections of the seismic-load resisting system; locations and dimensions of protected zones; and identify demand-critical welds. Identify members to be galvanized and those that are not to be shop primed. Obtain approval before beginning fabrication.

- C. Certifications:
 - 1. Steel: Furnish certified mill analyses and test reports establishing conformity to this specification for each heat prior to fabrication. Include names and locations of mills and shops, and chemical analysis and physical properties of steel.
 - 2. High Strength Bolts: Furnish certified test reports for each lot of bolts in accordance with ASTM F3125.
 - 3. Paint Products: Furnish certificates of compliance from the paint manufacturer attesting that paint products meet the requirements of this specification.
 - 4. Welders: Furnish copies of welders certification.
- D. Submit Welding Procedure Specifications.

1.5 QUALITY ASSURANCE

- A. Testing Agency: An inspection and testing agency shall be retained by the Owner for testing and inspection as required by drawings and specifications. Selected agency will follow requirements of ASTM E329, "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".
- B. Tests and inspections shall be performed and paid for in accordance with requirements of Division 01.
- C. Materials and work shall be subject to inspection at mill, fabricating plant, and building site. Material or workmanship not complying fully with drawings and specifications will not be accepted. Give laboratory reasonable notice when ready for inspection. No additional compensation will be paid for any work required to prepare for testing and inspection.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In general, material shall be of exact sizes, shapes, weight, and kinds provided for on drawings and specifications. However, with written permission of Architect & DSA, members built up from plates may be substituted for rolled shapes, at no additional cost to Owner, provided physical properties of original member such as section modulus, moment of inertia, etc., are met, and provided welding inspection costs associated with substitute built-up member are furnished at no additional cost to Owner.
- B. W Shapes: ASTM A992 Grade 50
- C. Other Structural Steel, Plates, Shapes and Bars: Conforming to ASTM A36.
- D. Hollow Structural Steel (HSS): Cold formed, ASTM A500 Grade B.
- E. Steel Pipe: ASTM A53/A53M, Type E or S, Grade 8. Standard weight unless otherwise noted.
- F. High Strength Bolts, Nuts and Washers ASTM F3125, Grade A325, ASTM A563 and ASTM F436 Respectively.
- G. Machine Bolts: ASTM A307.
- H. Threaded Rods: ASTM A36/A36M.
- I. Headed Anchor Bolts: ASTM F1554, Grade 36.

- J. Arc-Welding Electrodes not part of the SLRS: Conforming to AWS D1.1 for filler metal requirements, and recommended by their manufacturers for position and other conditions of actual use.
- K. Arc-Welding Electrodes part of the SLRS:
 - 1. Non Demand Critical Welds: shall conform to AWS D1.8.
 - 2. Demand Critical Welds: shall conform to AWS D1.8 DC.
- L. Shear Connectors: ASTM A108. Grades 1015 thru 1020, Headed Stud Type Cold Finished, carbon steel; AWS D1.1/D1.1M, Type B
- M. Paint: SSPC PS 2.03 or Federal Specification TT-P-86, Type II, (Tnemec #99).
- N. Galvanizing: Hot dip process; ASTM A123, to average weight of 2.3 oz./sq.ft. and minimum weight of 2.0 oz.

2.2 FABRICATION

- A. Structural Steel Fabrication: Comply with AISC "Specification for Structural Steel Buildings", latest edition.
- B. Camber structural steel members where indicated. Fabricate beams with rolling camber up.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
- D. Drill or punch holes for bolts. Do not make or enlarge holes by burning.
- E. Shop Connections: Made by bolting or welding, as detailed on drawings. If type of fasteners are not shown, use A325 with washers.
- F. Welding, Shop and Field: Weld by shielded arc method, submerged arc method, flux cored arc method, or other method approved by AWS. Perform welding in accordance with AWS Code. All welders, both manual and automatic, must be certified in accordance with AWS "Standard Qualification Procedure: for the work to be done. See paragraph "Welding" herein, for detailed requirements. If sizes of fillet welds are not shown on drawings, use AWS minimum weld size but not less than 3/16 inch fillet welds.
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1 and manufacturers written instructions.
- H. High Strength Bolts: Install in accordance with requirements of ASTM A3125. Connection shall be with threads excluded from the shear plane. If slip critical, indicate as SC and provide surface prep classification & requirements per RCSC specifications.
- I. Prior to fabrication, straighten all material by methods which will not injure material. Prior to assembling component parts of a connection, thoroughly clean all contact surfaces of loose scale, rust, burrs, etc., and remove local twists and bends.
- J. Surface Preparation:
 - 1. After fabrication, inspection, and acceptance; and before leaving shop, clean all steelwork to be encased in concrete or spray fireproofing by hand wire brushing, or by other means, elected by the fabricator, of loose mill scale, rust, weld slag or flux deposit, dirt and foreign matter in accordance with SSPC-SP-2. Remove oil and grease deposits by solvents.

2. Steelwork to be left exposed and which will be painted shall be cleaned by blast cleaning in accordance with SSPC-SP-7. Remove oil and grease deposits by solvent, SSPC-SP-1.
3. Clean and grind all areas subject to ultrasonic or radiographic inspection.
4. Surfaces within two inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

2.3 FINISHES

- A. Shop prime paint any structural steel which will NOT be encased in concrete, covered with sprayed fireproofing or plaster, or receive composite beam welded studs, or specifically noted, with one coat of specified primer. Include all parts of braces, brackets, and similar items. Do not shop prime surfaces to be galvanized, machined surfaces, contact surfaces, and edges and surface areas adjacent to field welds. Apply two coats to parts inaccessible after assembly or erection.
- B. Exterior Ferrous Metal and Interior Ferrous Metal Exposed to Continuing Moisture: Grind welds, burrs, and rough surfaces smooth after fabrication. Hot-dip galvanize completed assembly and provide one coat of shop prime paint.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Store material to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged material from corrosion and deterioration.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

3.2 INSTALLATION

- A. Erect structural steel with proper equipment and qualified riggers.
- B. Actively cooperate with other trades and provide incidental welding, connections, etc. for securement of work of others to structural steel framing.
- C. Erect temporary flooring, planking, and scaffolding necessary in connection with erection of structural steel or support of erection machinery. Use of temporary floors shall be as required by municipal or state laws and governing safety regulations.
- D. After erection, clean connections and abrasions to shop coat and spot paint with same primer used in shop.

3.3 ERECTION TOLERANCES

- A. Erection tolerances for structural steel work shall be in accordance with latest AISC 303.

3.4 BOLTING

- A. High strength steel bolts shall be used where indicated. Fabrication and erection shall be in strict accordance with the latest edition of "Specifications for Assembly of Structural Joints Using High-Strength Steel Bolts", as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation. Load indicator washers, or equivalent means of determining required tension, shall be used. Use beveled washers on sloping surfaces.

3.5 WELDING

- A. Welding and welded joints shall be in accordance with AWS standards. Work shall be performed by operators who have been qualified by test in accordance with AWS D1.1, "Structural Welding Code – Steel", to perform type of work required for this project.
- B. All methods, sequence, qualifications and procedures, including preheating, postheating, etc. shall be detailed in writing and submitted to Architect for review by the testing laboratory. Provisions shall be made in detailing of lengths of members for dimensional changes as a result of shrinkage stresses so as to provide specified finished dimensions.
- C. Remove all runoff tabs, and bottom backing bars. Top backup bars to be removed or have continuous fillet weld to column.

3.6 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.
- B. Touch-up Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.7 ANCHOR BOLTS

- A. Provide at site, for others to install, all anchor bolts, bearing plates, and templates to be embedded in concrete.
- B. Provide necessary steel templates and diagrams for setting and securing of such anchor bolts in concrete forms. For large templates, provide pour holes to facilitate concrete consolidation below as required.
- C. Be jointly responsible with others for proper locating and installing, and make good any deficiencies and errors.
- D. Setting of anchor bolts in hardened concrete necessitates drilled holes solidly grouted in place with epoxy grout. Submit materials and methods for review and approval.

END OF SECTION

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SECTION 05 3000

METAL DECKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Metal decking, complete, including required closures and flashings, miscellaneous angle supports at columns, and angle reinforcement at openings.
- B. Related Sections:
 - 1. Structural Steel Framing: Section 05 1200.

1.2 SUBMITTALS

- A. Comply with requirements of Section 01 3300, "Submittal Procedures."
- B. Shop drawings and erection drawings for all work shall be submitted and written approval thereof obtained before beginning fabrication or delivery of material to the building site. Show in detail all types, gauges, locations, and dimensions of openings; location and types of welds, and other pertinent data.
- C. Clearly mark or code units and erection drawings in such manner to permit ease of identification during erection and efficient sequence of erection.
- D. Mill test certificates shall be submitted to the architect for approval.
- E. Written procedures shall be submitted for each type and size of weld used, and shall be accompanied by independent laboratory test reports substantiating strength requirements for welds.
- F. Welders certifications.

1.3 QUALITY ASSURANCE

- A. All work shall comply with the following reference standards, unless modified by building code, or herein.
 - 1. Steel Deck Institute, SDI:
 - a. SPD2, Code of Recommended Standard Practice.
 - b. Publication No. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.
 - 2. American Iron and Steel Institute, AISI: S100, North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 3. American Welding Society, AWS: D1.3, Specification for Welding Sheet Steel in Structures.
 - 4. American Institute of Steel Construction, AISC: 360, Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.
- B. In case of conflict between the referenced specifications, the one having the most stringent requirement shall govern.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All metal decking shall be formed from galvanized sheet steel conforming to ASTM A653 and having a minimum yield strength of 33,000 psi. In no case shall unit design stress exceed the minimum yield strength of the steel divided by 1.65. Maximum working stress shall not exceed 20,000 psi.
- B. All metal decking shall have at least a two inch wide bearing surface at each rib to insure sufficient bearing and welding area on structural steel. All decking units shall be of sufficient length to extend over three or more spans, wherever possible. Units shall have welded or inter-locking edges to permit proper fastening to insure the transference of both lateral and vertical loads. Units shall be so formed that there is a gap between the top surfaces of adjacent ribs of at least two inches to provide sufficient space for working of concrete into open portion of deck.
- C. See Structural Drawings for metal deck type.

2.2 ACCESSORIES

- A. Flashing and closures shall be galvanized sheet steel as specified for decking, 18 gauge minimum, unless noted otherwise.
- B. Welding electrodes and equipment shall be recommended by deck manufacturer.
- C. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- D. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head, self-drilling, carbon-steel screws, #10 minimum size.
- E. Miscellaneous metal angle supports for decking at columns and at openings, in compliance with details on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. See Structural Steel Framing 05 1200, and coordinate deck placement with steel erector; provide same with necessary information as to load carrying ability of deck so that overloading and damage to decking does not occur. Deck shall be capable of withstanding normal light construction loads and traffic without being structurally damaged. Heavy loads and concentrated wheel loads from concrete carts, welding equipment, etc., shall be distributed by planking or other means as required.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Protect steel deck from corrosion, deformation and other damage during delivery, storage, and handling. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

3.3 DESIGN REQUIREMENTS

- A. Metal deck units shall be supplied in lengths to span over at least 3 supports.
- B. The load of any hanger shall not exceed 75 pounds. The total load from all hangers on a deck unit shall not exceed 250 pounds.
- C. Comply with physical properties indicated. See drawings for sectional profiles, minimum sections modules and moment of inertia, depths, and minimum gauges required.
- D. Provide vent and/or hanger tabs at all low flutes, at 2'-0" on center, maximum. At roof with waterproof coating and/or insulating concrete, provide sufficient vent holes per manufacturer's recommendations.

3.4 ERECTION

- A. Install all decking as per governing codes, Drawings, requirements, and manufacturer's specifications and recommendations.
- B. The decking units shall be placed on the supporting steel framework and adjusted to final positions before being permanently fastened. Each unit shall be brought to 2 inch minimum bearing on the supporting beams.
- C. If the supporting beams are not in proper alignment or at proper level within steel tolerances permitted under Structural Steel Framing 05 12 00, the work shall be corrected before the final placing of the decking units. Proceeding with final work implies acceptance of conditions.
- D. Decking units shall be fastened to supporting steel as shown on the structural drawings. Where two units abut, each unit shall be so fastened to the steel framing. All closures and flashings shall be tack-welded in place not more than two feet on center and shall be such as to completely prevent the entry of concrete into the cells, or leakage of concrete through the floor.
- E. An overlap of the male and female side joint lips of at least 5/8 inch shall be provided, and side joints shall be connected as shown on the drawings.
- F. Opening reinforcement shall be as detailed on the drawings. Cutting of holes other than those detailed on the drawings shall be done only as specifically approved by the architect. Holes not shown on structural drawings shall be cut and reinforced in accordance with details on metal decking drawings but shall be located and paid for by the trade requiring openings. See details on drawings for restrictions.
- G. The welding shall be done only by welders certified for welding in light gauge metal, using materials and methods in strict accordance with the manufacturer of the metal decking.
- H. Touch-up field weld and burned and abraded areas in shop finish using zinc dust primer paint.

3.5 FIELD QUALITY CONTROL

- A. Testing and Inspections: A testing agency selected by the owner will review mill test reports, weld procedures, qualifications of welders and will inspect the welding during erection. Costs of this service excluding retests, qualification of welders, and test of unidentified materials shall be paid for by the owner.

3.6 CLEANING AND REPAIR

- A. After erection, remove metal cuttings and construction debris from cells for entire length. Remove grease, oil, and other foreign material.
- B. Galvanizing repairs: Prepare and repair damage galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- C. Comply with clean-up requirements of General and Special Provisions.

END OF SECTION

SECTION 05 4100

STRUCTURAL METAL STUD FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Exterior and Interior load-bearing wall framing.
 2. Exterior and Interior non-load-bearing wall framing.
 3. Ceiling joist framing.
 4. Soffit framing.
 5. Shear resisting structural panels at shear wall locations.

1.2 REFERENCES

- A. Comply with applicable provisions of the following; latest editions unless otherwise specified.
1. American Institute of Steel Construction, AISC:
 - a. Specification for Structural Steel Buildings.
 - b. Code of Standard Practice for Steel Buildings and Bridges. Delete the following sentence from paragraph 4.2.1: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."
 2. American Iron and Steel Institute, AISI:
 - a. S200, North American Standard for Cold-formed Steel Framing – General Provisions.
 - b. S210, North American Standard for Cold-formed Steel Framing – Floor and Roof Systems
 - c. S211, North American Standard for Cold-formed Steel Framing – Wall Stud Design.
 3. American Welding Society, AWS: D1.1, Structural Welding Code.
 4. California Building Code, CBC, 2019 Edition with Amendments.
 5. Steel Structure Painting Council, SSPC: Surface Preparation Specifications.

1.3 SYSTEM DESCRIPTION

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - b. Ceiling Joist Framing: Vertical deflection of 1/480 for live loads and 1/360 for total loads of the span.

1.4 SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. Shop Drawings: Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification data.
- E. Product test reports.
- F. Research/evaluation reports.

1.5 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: ST33H
 2. Coating: G60

2.2 COMPONENTS - LOAD-BEARING AND SHEAR WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.0451 inch (33 mils).
 2. Flange width: 1 5/8 inches. Mill as shown on drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and same minimum base-metal thickness as steel studs.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C and T shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.0566 inch (54 mils).
 2. Flange widths vary with application; coordinate with wall width. C shape flange Width: 1-5/8 inches.

2.3 COMPONENTS - NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0346 inch (33 mils).
 - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

2.4 COMPONENTS - CEILING JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0346 inch (33 mils).
 - 2. Flange Width: 1-5/8 inches, minimum.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel joists.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.5 SOFFIT FRAMING

- A. Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0346 inch (33 mils).
 - 2. Flange Width: 1-5/8 inches, minimum.

2.6 ACCESSORIES – FRAMING MATERIALS

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.7 ACCESSORIES - MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.
- E. Shear Resisting panels: Sure-Board Series 200 Structural Panels as specified and detailed on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION - GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

- F. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 INSTALLATION - LOAD-BEARING AND SHEAR WALLS

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacing as shown on design drawings.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: 16 inches on center, unless noted otherwise on design drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing; and as detailed for installation of shear resisting panels.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches or as indicated on design drawings. Fasten at each stud intersection.

1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- K. Install shear resisting panels as shown on drawings and as required by IAPMO ER 126. Screw attachment shall be as indicated on drawings.

3.4 INSTALLATION - NON-LOAD-BEARING WALL

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 1. Stud Spacing: 16 inches unless otherwise noted in design drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 1. Install single deflection tracks and anchor to building structure.
 2. Install double deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on design drawings but not more than 48 inches apart. Fasten at each stud intersection.
 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at 96-inch centers.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.5 INSTALLATION - JOISTS

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacing indicated on design drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: 16 inches or as indicated on design drawings.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on design drawings.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on design drawings. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Custom-fabricated connectors and plates.
 - 2. Steel pipe downspouts.
 - 3. Miscellaneous concealed framing and supports including support system for countertops, and other miscellaneous concealed steel framing and supports not included under other Sections.
 - 4. Shop priming.
 - 5. Hot-dip galvanizing.
- B. Related Requirements:
 - 1. Painting and Coating: Section 09 9000.
 - 2. Solid Surfacing Countertops: Section 12 3661.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Coordination:
 - 1. Furnish setting drawings, diagrams, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors, to be embedded in concrete and masonry.
 - 2. Coordinate fabrication schedule with construction progress to avoid construction delays.
 - 3. Coordinate with other construction in order to ensure that actual dimensions correspond to established dimensions.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Large-scale drawings for fabrication and erection of assemblies not completely shown by manufacturer's product data.
 - 1. Show required field measurements and interface with work of other Sections.
 - 2. Welds, both shop and field, shall be indicated by AWS "Symbols for Welding, Brazing and Nondestructive Examination," A2.4.
- B. Product Data: Manufacturer's specifications for manufactured products to be used in the fabrication of work, including paint products, bolts, and other exposed hardware.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Certification for each welder.

- B. Completed "Procedure Qualification Record" (PQR) and "Welding Procedures Specification" (WPS) forms for the welds to be performed under this Specification in accordance with AWS D1.1. Weld procedure qualification shall be for the same joint to be welded through in project work.

1.5 QUALITY ASSURANCE

- A. Welding:
 - 1. Qualifications: Certified and qualified in accordance with AWS D1.1.
 - 2. Procedures and operations shall comply with AWS "Standard for Welding Procedure and Performance Qualifications," B2.1.
 - 3. Comply with AWS publication "Welding Zinc Coated Steel" for galvanized products.
 - 4. Welding inspector's qualifications shall be in accordance with AWS D1.1.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel from corrosion.
- B. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.7 FIELD CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Comply with recommended practices of the National Association of Architectural Metal Manufacturers (NAAMM) and Section 10 of the AISC Code of Standard Practice.
- B. Allow for thermal movement resulting from 100 degrees F change (range) in ambient temperatures, to prevent buckling, opening up of joints and overstressing of welds and fasteners.

2.2 METAL MATERIALS

- A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.
- B. Architectural and Miscellaneous Steel Items: ASTM A283, grade optional.
- C. Steel Tubing: ASTM A500 welded or seamless, grade as required for proper strength except where used structurally tubing shall have a strength of not less than $F_y = 46$ ksi.
- D. Steel Pipe: ASTM A53, Type E or S, Grade B for structural pipe; Grade A or Type F for railings and where bending is required.
- E. Downspouts: Schedule 40 pipe.

2.3 ADDITIONAL MATERIALS

- A. Fasteners: Provide type, grade, and class required for the particular use.
 - 1. Provide zinc-coated fasteners with galvanizing complying with ASTM A153 for exterior use or where built into exterior walls.
 - 2. Fastenings exposed to public access shall be designed to alleviate vandalism and theft.
- B. Welding:
 - 1. Electrodes: In accordance with AWS Code.
 - 2. Welding Filler Metal for Carbon Steel: AWS A5.1 or A5.5 E70XX for SMAW welding process, AWS A5.18 ER70S-X for GMAW welding process, AWS A5.17 or A5.23 F7X-E7XX for SAW welding process, and AWS A5.20 E7XT-X for FCAW welding process.
- C. Non-Metallic, Non-Shrink Grout: Premixed, conforming to ASTM C1107, with minimum compressive strength of 5000-psi at 28-days.

2.4 GALVANIZING

- A. Provide zinc coating for items exposed to exterior atmosphere, shown on the Drawings, or specified to be galvanized using the hot-dip process after fabrication in accordance with ASTM A385.
- B. Newly galvanized items shall not be water quenched or chromate quenched after galvanizing if they are scheduled to receive a paint coating.
- C. Exterior standard bolts, cast-in-place anchor bolts, and nuts shall be galvanized.

2.5 PROTECTIVE COATINGS

- A. Products:
 - 1. Galvanizing-Repair Paint: Minimum 82 percent zinc-dust-content paint for regalvanizing welds in galvanized steel; Z.R.C. Cold Galvanizing Compound by ZRC Worldwide, "Drygalv" by American Solder and Flux, or equal.
 - 2. Shop Primers for Ferrous Metal:
 - a. Interior: Modified alkyd; Tnemec Series "FD88 Azerox," or equal, applied to 1.5 to 2.5 mils DFT.
 - b. Exterior – Not Galvanized: Inorganic, zinc-rich: "Tneme-Zinc 90-97," or equal, applied to 2.0 to 3.5 mils DFT.
 - c. Exterior - Galvanized: Low VOC polyamidoamine epoxy' Tnemec "L69," or equal applied at 2.0 to 3 mils DFT.
 - 3. Field-Applied Finish Paints: As specified in Section 09 9000, "Painting and Coating."
- B. Preparation of Galvanized Surfaces for Priming: SSPC No. 1 and additional recommendations included in the AGA document "Suggested Specification for Preparing Hot Dip Galvanized Surfaces for Painting."
- C. Shop Priming: In accordance with the following surface preparation and SSPC PA1, "Shop, Field, and Maintenance Painting."
 - 1. Galvanized Surfaces: As specified.
 - 2. Concealed Items: SSPC-SP No 3, "Power Tool Cleaning."
 - 3. Exposed Items: SSPC-SP No. 6/NCACE No. 3 "Commercial Blast Cleaning."
- D. Finish Painting: As specified in Section 09 9000, "Painting and Coating."

2.6 FABRICATED ITEMS

- A. Countertop Support Bracket: Steel, with 1/2 inch arm for non-visible arm installation under 1-1/2 inch depth of countertop edge, and predrilled holes; A & M Hardware, Inc. as specified, or equal.
 - 1. Profiles: 2-inch "Concealed Flat" Models CFLAT and ECLAT.
 - 2. Support Arm Length: 24 inches.
 - 3. Weight Capacity per Pair: Not less than 1,000 pounds.
 - 4. Finish: Manufacturer's powder coat in available color as selected by Architect.
 - 5. Mounting Fasteners: Carriage bolts as provided by manufacturer.

- B. Miscellaneous Framing and Supports:
 - 1. Provide miscellaneous steel framing and supports as required to complete the Work.
 - 2. Fabricate to sizes, shapes, and profiles shown or required.
 - a. Except as otherwise shown, fabricate from structural steel shapes, plates, and steel bars, of all-welded construction, using mitered corners, welded brackets and splice plates, and a minimum number of joints for field connection.
 - b. Cut, drill, and tap units to receive items anchored to the Work.
 - 3. Galvanize miscellaneous framing and supports wherever indicated and used in an exterior location.

PART 3 - EXECUTION

3.1 PREPARATION

- A. At the time of connecting, bearing surfaces shall be free from loose or non-adherent rust, loose mill scale, oil, grease, dirt, mud, and any foreign matter, coating, or defect that adversely affects the connection.

- B. Surface preparation for welding shall be in accordance AWS D1.1, except loose or non-adherent rust, loose mill scale, and paint shall be removed by wire brushing.

- C. Corrosion Protection: Protect surfaces that are in contact with concrete or masonry, or contact surfaces of dissimilar metals by coating the contact surfaces of each with two heavy coats of bituminous paint, or by suitable isolation gaskets, as approved and as applicable for each condition. Do not extend coating onto exposed surfaces.

3.2 INSTALLATION

- A. Install metal fabrications as shown on the Drawings in accordance with reviewed submittals and referenced standards including allowable tolerances as defined in the AISC "Code of Standard Practice for Steel Buildings and Bridges."

- B. Cut, drill, and fit as required for installation.

- C. Provide grouting for work of this Section using specified grout in accordance with manufacturer's directions.

- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.

- E. Set work accurately in location, alignment, and elevation; plumb, level, true, and free of rack; measured from established lines and levels.

- F. Adjust items prior to securing in place so as to ensure proper matching of components and correct alignment.

- G. Anchors and Fastening:
 - 1. Connections shall be as shown on the Drawings and reviewed submittals.
 - 2. Anchor bolts shall be placed within the allowable tolerances as defined in the AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 3. Cast-in-place miscellaneous metals and fasteners shall be installed and set by template prior to concrete placement.
- H. Holes that require enlarging to admit bolts shall be reamed. Holes shall not be enlarged by flame cutting.
- I. Field welding shall comply with requirements specified for shop welding. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

3.3 FIELD QUALITY CONTROL

- A. Wedge and expansion nut-type concrete anchor and resin/adhesive anchor installation shall be inspected in accordance with special inspection requirements of the CBC.
- B. Inspection of welding shall be in accordance with AWS D1.1 the special inspection requirements of the CBC with all welds visually inspected. Acceptance of welding inspection results shall be in accordance with of AWS D1.1.

3.4 ADJUSTMENT AND TOUCH-UP

- A. Inspect installed work. Correct deficiencies.
- B. Field Galvanizing Repair: Wire brush welds and damaged coating to clean bright metal and apply one coat of galvanizing repair paint.
- C. Clean field welds; field bolts, and all damaged shop primer after erection and apply a spot coat of the same primer as used for the shop coat in compliance with coating manufacturer's requirements.

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SECTION 06 2013

SITE CARPENTRY

PART 1 - GENERAL

1.1 PROVISIONS

- A. The requirements of the General Conditions, Supplementary Conditions, and Division 1, General Requirements apply to the work of this Section.

1.2 INCLUDED WORK

- A. Provide Exterior wood construction as shown and specified on the Landscape Drawings. The work includes:
 - 1. Wood planter walls
 - 2. Wire gopher deterrent (hardware cloth)

1.3 RELATED WORK

- A. Section 31 2000 – EARTHWORK AND GRADING
- B. Section 05 5000 – METAL FABRICATIONS
- C. Section 03 3000 – CAST-IN-PLACE CONCRETE

1.4 REFERENCES AND STANDARDS

- A. Lumber: Comply with American Softwood Lumber Standard PS-20-05. Provide lumber species complying with grading rules of following associations.
 - 1. Douglas Fir: Western Lumber Grading Rules, published by Western Wood Products Association (WWPA), or Standard Grading Rules for West Coast Lumber, Number 16, published by West Coast Lumber Inspection Bureau (WCLIB).
 - 2. Western Spruce, Pine, and Fir: Western Spruce-Pine-Fir Association (WSPFA) and current Canadian Grading Rules by National Grades Association Canada.
- B. Redwood: "Standard Specification of Grades of Redwood Lumber" of the California Redwood Association (CRA).
- C. Plywood: Grade-marked and manufactured in accordance with U.S. Product Standard PS-1-74, Softwood Plywood Construction and Industrial or one of American Plywood Association (APA) performance standards.
- D. Design and detailing of wood framing connections: National Forest Products Association (NFPA) National Design Specifications for Wood Construction.
- E. Fasteners and nails: comply with NFPA Recommended Nailing Schedule of the Manual for House Framing.
- F. Wood Treatment: American Wood Preservers Association (AWPA) standards for wood preservative treatment scheduled.
- G. California Building Code, Chapter 23, 2013 Edition, unless otherwise noted.

H. American Society for Testing and Materials, (ASTM).

1.5 QUALITY ASSURANCE

- A. Landscape Carpentry work shall comply with these specifications and all applicable sections of the above-named References and Standards.
- B. Provide each piece of plywood and/or lumber, factory grade-marked.

1.6 SUBMITTALS

- A. Wood Treatment Data: Submit certification by treating plant indicating chemicals and process used and compliance with specified requirements.
- B. Submit manufacturer's product data for rough carpentry accessory and hardware items.
- C. Hardware cloth: 6" square sample.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFMs.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials dry during delivery and site storage. Stack materials to ensure proper drainage and ventilation. Protect from weather damage and deterioration.
- B. Store and protect rough hardware from weather damage and deterioration.

1.8 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work. Scribe and cope as required for accurate fit. Coordinate location of nailers, blocking, and similar supports to allow proper attachment of other work.
- B. Layout, cut, fit, and erect framing for rough and finished work. Provide blocking, nailers, and all other rough carpentry work. Do cutting work in connection with carpentry work for other trades. Brace, plumb, and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws, and bolts as necessary.
- C. Lay out project work, set stakes, and batter boards.

- D. Provide wood framing, nailers, bracing, and supports required to support construction during formative stages. Set wood framing accurately to required lines and levels. Anchor members securely in place.
- E. Provide temporary rough carpentry work as indicated or required to construct the work. Maintain temporary items for the life of the work. Remove when no longer needed.
- F. Furnish and install miscellaneous hardware in connection with carpentry work.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber:
 - 1. Nominal sizes are indicated. Provide actual size complying with PS-20-05 for moisture content indicated for each use, except where net sizes are indicated by detail dimensions.
 - 2. Provide dressed dimensioned lumber, S4S, kiln-dried or air-dried with maximum 19% moisture content.
 - 3. Provide rough sawn lumber, kiln-dried or air-dried with maximum 19% moisture content.
 - 4. Provide Western lumber WWPA, WCLIB, CRA or WSPFA species meeting stresses and grades scheduled.
 - a. All redwood to be deck heart construction grade
 - 5. Provide lumber pressure preservative treated, where wood comes into contact with soil and wherever indicated on the Drawings.
- B. Plywood: Provide exterior use rated panels manufactured with waterproof exterior type glue line, thickness indicated on the Drawings. Douglas Fir AA-X exterior.
- C. Hardware Cloth: 1/2" x 1/2" x 36", 19 gauge, hot dipped galvanized after weaving.
- D. Stainless steel wire
 - 1. Stranded wire, 3/16" diameter.
- E. Rough Hardware:
 - 1. Furnish bolts, plates, anchors, hangers, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to structures.
 - 2. Provide manufactured or fabricated items of sizes, shapes, and dimensions required.
 - 3. Bolts: ASTM A307, provide with malleable iron washers.
 - 4. Steel: ASTM A36.
 - 5. Mild Steel: ASTM A 283.
 - 6. Fasteners and anchorages: Provide size, type, material, and finish required for nails, screws, bolts, nuts, washers, and anchoring devices. Provide with aluminum, stainless steel or hot-dip galvanized finish fasteners and anchorages size and type to suit application.

7. Provide toggle bolt type anchorage of framing to hollow masonry and expansion shield and lag bolt type for anchorage to solid masonry or concrete and bolts or power activated type for anchorage to steel.
8. Metal connectors: Galvanized steel hangers, ties, and anchors sized for full load carrying capacity of supported members. Simpson or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which carpentry work is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Obtain field measurements and verify dimensions and details before proceeding with rough carpentry work.

3.3 INSTALLATION

- A. Set wood framing accurately to required lines and levels. Provide with framing members of sizes and on spacings shown. Cut, join, and tightly fit framing around other work. Do not splice structural members between supports.
- B. Set posts plumb and true to line and grade.
- C. Use only treated, sound, thoroughly seasoned materials of longest practical lengths and sizes to minimize joints. Use materials free of warp unless warp can be easily corrected by anchorage and attachment. Make tight connections between members. No shimming will be allowed.
- D. All wood surfaces shall be sanded where necessary to remove undesirable rough edges. All knot holes, pitch pockets, or sappy portions shall be sealed with an approved resin sealer.
- E. Metal work shall be fabricated to the details shown, shall have all brackets necessary for the attachment of woodwork.
- F. Select individual pieces of lumber so that knots and obvious minor defects will not interfere with placing of bolts, proper nailing, or making of proper connections. In exposed locations, select for appearance satisfactory to the Architect.
- G. Framing shall be closely fitted, accurately set in plumb planes to required lines and levels and rigidly secured in place. Beams shall be set with crowned edge up; bottom edges shall be free from pronounced defects. Special framing or construction, not explicitly shown or specified, shall be provided as directed by the Architect to complete work in the best workmanlike manner.
- H. Provide all bolting, nailing and other fastenings required to complete the wood construction shown on the Drawings.
- I. Bolt holes shall be 1/32-inch to 1/16-inch larger than bolts, and shall be accurately located to permit proper alignment of members and easy driving of bolts. A malleable iron washer, or the equivalent thereof, shall be installed between each bolt head and nut and wood. Bolts shall be taken up snug and shall be retightened at the latest practicable time during the construction work.
 1. Vandal-proof all bolting and other connections by burring threads.

- J. Anchor and nail framing to comply with NFPA Recommended Nailing Schedule of the Manual for House Framings.
- K. Nailing shall be done in a workmanlike manner; care being exercised to avoid splitting wood. All nailing clips, hangers, and the like shall receive full number of nails of proper size as furnished with clips or recommended in manufacturer's printed instructions.
- L. Edges of handrails, beams, etc. where contact with people will occur shall be rounded and smoothed.
- M. Provide sill plates where wood framing is supported by concrete or masonry. Anchor to embedded bolts.
- N. Brush apply 2 coats of an acceptable wood preservative to surfaces of preservative treated lumber that are field cut, dressed, or drilled.
- O. Prior to filling the boxes with soil, install the hardware cloth, turn down the wire into the soil and staple it to the edges of the box.

3.4 CLEANING

- A. Clean up debris and cuttings on a regular periodic basis.
- B. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, tools, and equipment. Repair damage resulting from rough carpentry work.

END OF SECTION

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Custom casework of the following types as indicated on the Drawings.
 - a. Solid stock wood, paint grade
 - b. Plastic-laminate-faced.
2. Electric conduit and junction boxes concealed within casework.
3. Preparation of casework for utilities.
4. Installation of casework lighting fixtures.
5. Finish hardware and accessories for casework.

B. Related Requirements:

1. Resilient Flooring: Section 09 6500; resilient base at cabinets.
2. Solid Surfacing Countertops: Section 12 3661.
3. Electrical: Division 26; connection of casework power lines to building service, including any adapters for electrical work at Project site; lamps for lighting fixtures.

1.2 DEFINITIONS

- A. Unless otherwise specified, exposed, semi-exposed, and concealed surfaces shall conform to the cabinet surface terminology in Section 10 - Casework of the "North American Architectural Woodwork Standards (NAAWS)," published jointly by WI and AWMAC.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing and electrical rough-in.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Prepare for each casework layout following the recommendations for preparation of shop drawings in NAAWS Section 1 Article entitled "Submittals."
 1. Indicate materials, assembly methods, joint details, fastening methods, accessory listings, location of hardware, cutouts for switches, outlets and other accessories, and schedule of finishes for each casework item.
 2. Show mechanical, electrical, and building items in and adjacent to casework.
 3. Show dimensioned locations and types of blocking and other anchors to be built into substrates before being enclosed.
 4. Show grain direction for wood veneer including matching of adjacent leaves and matching between adjacent panels.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.
- C. Product Data: Manufacturer's published product literature for hardware, MDF, laminates, and shop-applied coatings.
- D. Samples:
 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
 2. Solid Stock: 16-inch long with stepped finish.

3. Thermoset Decorative Panels: 12 by 12 inches for each color.
4. Hardware:
 - a. Exposed items including pulls.
 - b. Other hardware items as requested by Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Statement of fabricator qualifications.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 1. Fabricator: Firm specializing in quality architectural cabinetwork and active member of WI or AWI. Fabricators not active members of WI or AWI will be considered upon submission of verifiable evidence of experience in successful completion of work similar to work of this Project.
 2. Installer: Supply an adequate number of skilled workers, thoroughly trained, experienced, and familiar with the necessary crafts and methods needed for proper performance of the work of this Section.
- B. Casework of this Section shall be fabricated by a single firm.
- C. Wood under this Section does not need to be pressure- and or fire-retardant treated.
- D. Mockups:
 1. A mockup shall be prepared for each required finish; wood veneer and plastic laminate.
 2. Mockup shall include a cabinet door, drawer front, and frame to verify selections and modifications made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution for cabinet exteriors, interior construction, and hardware.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work.
 - a. Wood veneer mockup shall show layup of multiple veneer flitches if other than engineered sheet is used.
 - b. Plastic laminate shall show minimal, non-visible edge and field joints.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas.
- B. When casework is stored at the site, and during and after installation, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Standard for Materials and Workmanship: Comply with applicable requirements of the NAAWS. Where Contract Documents show requirements that conflict with or augment this standard, comply with the most stringent requirements.

2.2 WOOD MATERIALS

A. General:

1. Moisture Content at Time of Fabrication: As specified in woodworking standard.
2. Provide wood dressed on all exposed faces.
3. Do not use twisted, warped, bowed, or otherwise defective wood.
4. Sizes indicated on Drawings are net actual size, unless otherwise indicated.
5. Do not mark or color material, except where such marking will be concealed in finish work.
6. Wood is not required to be fire-retardant treated.
7. Lumber shall be free of sapwood, knots, pitch, or resin.

B. Solid Stock at Opaque Finish (Painted):

1. Species: Poplar, or equal hardwood.
2. NAAWS Grade: Custom.
3. Surfacing: Smooth.

2.3 PANEL MATERIALS

A. Plywood: Exterior type, Grade B-C or better. Plywood to be free of urea-formaldehyde.

B. Medium-Density Fiberboard (MDF): ANSI A208.2, formaldehyde free; "Meditate II" by Roseburg Forest Products, or equal.

1. Density: 48 lb/ft³.
2. Type: Grade 155.
3. Thickness: 3/4 inch, unless otherwise shown or required to meet NAAWS performance requirements.
4. Provide MDF meeting MR50 moisture resistant at sinks and other interior high moisture areas; "Medex" by Roseburg Forest Products, or equal.

C. Thermally-Fused Melamine Panels (TFM): Melamine resin-impregnated decorative paper thermally fused to a formaldehyde free particle board or MDF core.

1. Color: White.

D. Hardboard: Tempered Grade, conforming to standards of American Hardboard Association or PS-50; use smooth side exposed.

1. Thickness: 1/4 inch, unless otherwise noted.

E. Particle Board: Not permitted.

2.4 LAMINATE MATERIALS

A. High-Pressure Color Through Laminate: "ThruColor" by Panolam Industries International, "Solicolor" by Wilsonart LLC or equal conforming to NEMA LD3 and ISO 4586 Parts 1 and 2.

1. Grades:
 - a. Horizontal Surfaces: ISO 10/HGS; horizontal, general purpose, standard.
 - b. Vertical Surfaces: ISO 20/VG; vertical, general purpose.
 - c. Cabinet Liner (If Specified TFM Panel is Not Used): ISO 72/CLS, cabinet liner, standard.
 - d. Backing Sheet: ISO 91/BKL; backer, light duty.
2. Colors and Patterns:
 - a. Exposed: As selected by Architect.
 - b. Cabinet Liner: White.

B. Edge Banding: 0.018 inch ABS, machine applied, or approved equal non-PVS product.

2.5 HARDWARE

- A. General: Comply with requirements of BHMA A156.9, Type 2 (Institutional).
- B. Finishes:
 - 1. Exposed Items: Satin chromium plated, 626, unless otherwise specified or noted on the Drawings, and complying with ANSI/BHMA A156.18.
 - 2. Concealed Items: Manufacturer's standard finish, complying with applicable product class of ANSI/BHMA A156.9, BO1521-3, Grade 1.
- C. Hinges: Five knuckle, institutional, wrap-around hinges exceeding ANSI/BHMA 156.9 Grade 1 requirements; "Rockford Process Control" (RPC-376), or equal.
 - 1. Height: 2-1/2 inches.
 - 2. Do not "let-in" hinges into door.
 - 3. Opening: 270 degrees.
- D. Drawer Slides: Accuride, or equal.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200).
 - 2. Side mounted; full-overtravel-extension type; zinc-plated steel ball-bearing slides.
 - 3. Capacity, per Pair: 200 pounds.
 - 4. In addition to capacity, slides shall be sized in accordance with manufacturer's recommendations for drawer width.
- E. Door and Drawer Pulls: Wire Type, 4-inches long, Häfele #116.39.446, Stanley, EPCO, or equal.
 - 1. Material: Type 304 stainless steel, satin finish.
 - 2. Unless otherwise indicated, provide one for each door or drawer, two for each drawer 30 inches or wider.
 - 3. Mounting Direction: As shown and noted on the Drawings, unless otherwise noted on reviewed submittals.
- F. Shelf Supports: Häfele #282-11-707 or equal for insertion into 5 mm holes.
 - 1. Spacing: As indicated on the Drawings.
- G. Locks: Schlage Cabinet Locks, CL Series, CompX National, or equal.
 - 1. Locations: Provide where indicated on the Drawings.
 - 2. Cylinders to be keyed into door keying system specified in Section 08 7100, "Door Hardware."
- H. Bumper Pads (Silencers): Hemispherical, quiet clear type, 55 Shore A hardness; 3M Bumpon Protective Products, or equal.
- I. Additional Hardware: As indicated on the Drawings.

2.6 ACCESSORIES AND ADDITIONAL MATERIALS

- A. Fasteners: Type and size as required.
- B. Adhesives: VOC compliant; do not use adhesives that contain urea formaldehyde.

2.7 FABRICATION

- A. General:
 - 1. Obtain field measurements and verify dimensions are as indicated on shop drawings before fabricating casework.

2. Shop-assemble casework for delivery to site in units easily handled and to permit passage through building openings and transportation facilities.
 3. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
 4. Conceal all fasteners.
- B. Grades:
1. Plastic-Laminate-Clad Casework: NAAWS Custom Grade.
- C. Carcass Construction: Type A frameless. Provide as single unit at open shelving.
- D. Door and Drawer Front Style: Flush overlay, NAAWS Style A. Drawer and door panel edges shall be square.
- E. Backs of doors and drawer fronts shall be finished to match front of door and drawer.
- F. Interior carcass surfaces behind solid doors shall be considered semi-exposed surfaces.
1. Finish at Plastic Laminate Casework: Specified Thermally-Fused Melamine Panels.
- G. Holes for shelf support clips shall be provided at 1-inch on center.
1. Locations shall be confirmed with Architect and shown on shop drawings.
 2. Bottom side of shelf ends shall be routed to receive and conceal clips.
- H. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- I. Non-Wood Countertops Integral with Custom Casework: As specified in respective Section in Division 12.

2.8 SHOP FINISHING

- A. General:
1. Do not apply finishes until sample submittals are reviewed and approved by the Architect.
 2. Coatings shall be shop applied and comply with NAAWS Premium Grade requirements.
 3. Apply entire finish in shop. Final touch-up cleaning and polishing may be performed after installation.
 4. Prepare for finishing in accordance with the woodworking standard.
- B. Back Painting: Surfaces which are not exposed to view at any time shall be thoroughly back painted with one heavy coat of finishing material of fabricator's choice before leaving the shop.
- C. Plastic Laminate Finish:
1. Exposed surfaces shall be finished with specified high-pressure laminate.
 2. Apply plastic laminate finish in full uninterrupted sheet consistent with manufacturer's sizes.
 3. Shelving shall be finished with high-pressure laminate.
 4. Fit corners and joints hairline; secure with concealed fasteners.
 5. Securely bond laminated plastic to MDF panel product; do not use plywood.
 6. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 7. Do not miter corners of laminated plastic.
 8. Cap exposed finish edges of plastic laminate casework.
 9. Shelving, door, and drawer front panels shall be self-edged. Low-pressure laminate, PVC, or other edging materials are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify painting, mechanical, electrical, and other work that will be concealed by casework, are completed.

3.2 INSTALLATION

- A. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- B. Install cabinetwork plumb and level and in conformance with requirements of NAAWS and as shown.
 - 1. Shim as necessary with concealed shims.
 - 2. Accurately scribe and closely fit faceplates and filler strips to irregularities of adjacent surfaces.
 - 3. Fasten base and wall cabinets to substrate and backing as shown.
 - 4. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - 5. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Install sealant as specified in Section 07 9200 "Joint Sealants" as required to close any small unavoidable gaps between casework and abutting surfaces. Sealant shall not be a substitute for tightly scribed work.

3.3 ADJUSTING AND CLEANING

- A. Adjust moving or operating parts to function smoothly and correctly.
- B. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION

SECTION 06 6420

REINFORCED PLASTIC WALL PANELING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fiber-reinforced plastic wall paneling (FRP).
 - 2. Installation accessories.
- B. Related Requirements:
 - 1. Joint Sealants: Section 07 9200.
 - 2. Gypsum Board: Section 09 2900.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's literature describing materials and installation instructions.
- B. Samples:
 - 1. Panels, 8 inch square, in specified color and finish and showing typical groove intersection.
 - 2. Trim pieces, 8 inch lengths.

1.4 QUALITY ASSURANCE

- A. Materials and installation shall meet USDA/FSIS requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to jobsite, place materials in area protected from weather.
- B. Protect materials from breakage and damage while unloading and when stored.
- C. Comply with additional requirements specified in Section 01 6100, "Materials and Equipment."

PART 2 - PRODUCTS

2.1 WALL PANELING

- A. Glass-Fiber-Reinforced Plastic (FRP) Wall Panels by Marlite, Kal-Lite, or equal.
 - 1. Size: 48 inches wide x height as shown.
 - 2. Thickness: 0.090 inch.
 - 3. Groove Configuration and Color: As scheduled. Refer to Finish Schedule on the Drawings.
 - 4. Texture: Pebbled.

5. Flammability:
 - a. Flame Spread, ASTM E84: Less than 200.
 - b. Smoke Developed, ASTM E84: Under 450.

- B. Trim: Manufacturer's matching solid polymer moldings for corners, end caps and division bars at joints between panels.

2.2 ACCESSORIES

- A. Sealant: Silicone type, as provided by panel manufacturer. Color to match wall panels.
- B. Adhesives: VOC compliant, high quality, low odor, non-flammable, water and mold resistant, latex-based as recommended or provided by panel manufacturer.
- C. Provide fasteners, trim, clips, cleaner and other materials as recommended by panel manufacturer and required for a complete installation.

PART 3 - EXECUTION

3.1 WALL PANELING INSTALLATION

- A. Install panels with manufacturer's recommended gap for panel field and corner joints.
- B. Set panels on top of flooring base. Secure to walls with adhesive in accordance with panel manufacturer's instructions.
- C. Install matching trim at corners and other exposed edges.
- D. Install panels vertically, cut to required height, without horizontal joints. Where used as a wainscot 48-inches or less in height, install horizontally without vertical joints except where wall length exceeds maximum available panel length. Joints shall be balanced on each wall with each end panel of equal width or length and not less than one-half full size.
- E. Seal joints between panels remaining after installation with silicone sealant.

3.2 CLEANING

- A. Clean soiled or discolored surfaces after installation.
- B. Remove and replace damaged or improperly installed work.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermal blanket insulation.
 - 2. Foam insulation at exterior wall crevices and spaces requiring a thermal seal.
- B. Related Requirements:
 - 1. Acoustical Insulation and Sealants: Section 09 8200; interior acoustic insulation and sound isolation requirements.
 - 2. Plumbing: Division 22; plumbing pipe insulation.
 - 3. Mechanical: Division 23; mechanical pipe and duct insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation recommendations for each type of insulation.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation recommendations for each type of insulation required.

1.5 QUALITY ASSURANCE

- A. Insulation shall be certified by manufacturer to comply with State standards for insulating materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.
- B. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

PART 2 - PRODUCTS

2.1 BLANKET INSULATION

- A. General: Provide sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

- B. Kraft-Faced Miner-Fiber Blankets: Lightweight fiberglass with non-reflective Kraft facing, formaldehyde free, conforming to ASTM C665 Type II, Class C, Category 2; "EcoTouch PINK Fiberglas Insulation" by Owens Corning, "Formaldehyde-free" Kraft-faced insulation by Johns Manville, "CertaPro" Thermal Kraft Faced Batts by CertainTeed Corporation, or equal.
 - 1. Fire Resistive Requirements: ASTM E84.
 - a. Facing: No requirements.
 - b. Blanket:
 - 1) Smoke Developed: 50 or less.
 - 2) Flame Spread: 25 or less.
 - 2. Thickness: As shown or noted on the Drawings.
- C. Unfaced Miner-Fiber Blankets: Lightweight fiberglass with non-reflective Kraft facing, formaldehyde free, conforming to ASTM C665 Type I; "EcoTouch PINK Fiberglas Insulation" by Owens Corning, "Formaldehyde-free" insulation by Johns Manville, "CertaPro" Thermal Batts by CertainTeed Corporation, or equal.
 - 1. Fire Resistive Requirements: ASTM E84.
 - a. Smoke Developed: 50 or less.
 - b. Flame Spread: 25 or less.
 - 2. Thickness: As shown or noted on the Drawings.

2.2 ACCESSORIES

- A. Perimeter Gap Sealant: Gun-dispensed, aerosol foam polyurethane or polyisocyanurate type conforming to ASTM C1620; Hilti "CF 810/812, or equal.
- B. Staples, Wire and Straps: Galvanized, to secure insulation in place.

PART 3 - EXECUTION

3.1 INSTALLATION OF THERMAL BLANKETS

- A. Install faced blankets with facing to building interior.
- B. Install to fill all typical and odd spaces completely in framing where required, other than providing air space where indicated.
- C. Install snugly between framing members.
- D. Trim to required height and width in place.
- E. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations. Split blankets around wires as required.
- F. Shim space between framing and window and door jambs shall be filled solid with unfaced batt or foam-in-place insulation. Fill spaces completely to a uniform monolithic density without voids.
- G. Where wall blankets are not in contact with gypsum board, provide straps to prevent sagging.

3.2 PROTECTION

- A. Coordinate with other Sections for prompt installation of finishes. Where coordination with other Sections is not practical, protect insulation by temporary covering or enclosure.
- B. Prior to applying overlying materials, obtain Architect's approval of insulation installation.

END OF SECTION

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SECTION 07 2200

ROOF BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Fiberglass-mat faced gypsum roof boards.
- B. Related Requirements:
 - 1. Metal Roof Panel: Section 07 4113.
 - 2. Sheet Metal Flashing and Trim: Section 07 6200

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout Procedures," Section 01 7800, "Project Record Documents."
- B. Coordination: Erection of the roof board shall be coordinated with the roofing installation so the roofing is applied as soon as possible after insulation is in place.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for roof board insulation.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Insulation shall be certified by the manufacturer to comply with California Standards for insulating materials.
 - 2. Insulation shall be comply with Flame Spread Rating and Smoke Density requirements of CBC.

1.5 DELIVERY AND STORAGE

- A. Store materials off ground, protected against weather, condensation, and damage.
- B. Comply with manufacturer's recommendations for handling, storage, and protection during installation.
- C. Comply with additional requirements specified in Section 01 6100, "Materials and Equipment."

1.6 WARRANTY

- A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's fully executed written warranty for nailable roof insulation board against defects in materials and workmanship for a period of 15 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: GP Gypsum, DensDeck® Roof Boards.
- B. Acceptable Manufactures:
 - 1. Johns Mansville
 - 2. GAF
 - 3. Hunter

2.2 MATERIALS

- A. Fiberglass Mat Faced Gypsum Roof Board
 - 1. Thickness: 1/2 inch.
 - 2. Width: 4 feet.
 - 3. Length: 8 feet.
 - 4. Weight: 2.0 lb/sq. ft.
 - 5. Surfacing: Fiberglass Mat.
 - 6. Flexural Strength, Parallel (ASTM C473): 80 lbf, minimum.
 - 7. Flute Span (ASTM E661): 5 inches.
 - 8. Permeance (ASTM E96): Greater than 35 perms.
 - 9. R-Value (ASTM C518): 0.56.
 - 10. Water Absorption (ASTM C473): Less than 10 percent of weight.
 - 11. Surface Water Absorption (ASTM C473): Nominal 2.5 grams.
 - 12. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
 - 13. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development.
 - 14. Combustibility (ASTM E136): Noncombustible
 - 15. Fire resistance rating (UL 790 and ASTM E108): Class A
 - 16. Mold Resistance (ASTM D3273): Scored a 10
- B. Fasteners: Light-Duty drill point fasteners of length to assure that fasteners penetrate through the metal deck.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate surfaces to receive insulation and associated work and conditions under which insulation will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- B. Verify deck and surfaces are clean, smooth, dry, free of depressions or irregularities prior to beginning installation of materials

- C. Verify roof openings, curbs, pipes, sleeves, ducts, penetrations or vents through roof are solidly set, wood nailing strips are in place.
- D. Verify all specifications related to Carpentry; have been followed prior to beginning installation of insulation. Beginning installation means acceptance of substrate.

3.2 PROTECTION

- A. During execution of work covered by this Section, the Contractor shall provide protection for roof insulation from water and wind penetration at the end of each day's work.
- B. Protect the roof insulation in areas that will receive excessive traffic with a surface protection such as plywood.
- C. All workmen shall wear clean, soft rubber-soled shoes for any application work where they may be walking on the in-place insulation

3.3 INSTALLATION OF ROOF BOARD INSULATION

- A. Install insulation board over metal decking with mechanical fasteners in accordance with manufacturer's instructions and as required to meet FM Class 1 wind-uplift classification I-90
- B. Apply only as many roof boards as can be covered by a roof membrane system in the same day.
- C. Board edges and ends shall be butted tightly together; do not gap edges or ends.
- D. Installation Directly on Metal Decking:
 - 1. Install roof boards with long edges bearing on and parallel to top flutes, so that edges are supported.
 - 2. Stagger roof board end and edge joints minimum 6".
 - 3. Adhesive installation: Adhere roof boards to metal deck using adhesive as recommended by roofing system manufacturer's product data. Apply overall pressure to ensure full adhesion. Do not slide into place.
- E. Prepare completed installation for application of overlying roofing by checking for uneven edges and grinding or sanding to provide a flush surface at joints.

END OF SECTION

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SECTION 07 2616

BELOW-GRADE VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Vapor retarder under concrete slab-on-grade.
- B. Related Requirements:
 - 1. Cast-in-Place Concrete: Section 03 3000.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's literature for vapor retarder with test result data indicating conformance with paragraph 8.3 of ASTM E1745.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor Retarder: "Stego Wrap Vapor Barrier -15-MIL" by Stego Industries, LLC, "Moistop Ultra 15" by Fortifiber, or equal meeting the following:
 - 1. Permeance as tested before and after mandatory conditioning in accordance with ASTM E1745: Less than 0.01 Perms (grains/(hr ft² hr Hg)).
 - 2. Other Performance Criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum.
- B. Vapor-Retarder Tapes:
 - 1. Self-adhering type designed to maintain vapor retarder integrity, 4-inches wide; "Stego Tape," or equal.
 - 2. Double-sided adhesive strip used to bond and seal vapor retarder to concrete, metal, and other surfaces; "StegoTack Tape," or equal.
- C. Liquid-Applied Vapor Retarder Membrane: Medium-viscosity, water-based, polymer-modified anionic bituminous/ asphalt emulsion; "Stego Mastic," or equal
- D. Pipe Boots: Fabricated from vapor barrier material and pressure sensitive tape in accordance with manufacturer's instruction; "Stego Pre-Cut Pipe Boots," or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check that areas to receive vapor retarder are clean and dry.
- B. Check that pipes, vents, drains, and other penetrations of the membrane are completed.
- C. At nails, screws, and other items that might penetrate vapor retarder, apply heavy beads of caulking compound or manufacturer's pressure-sensitive tape.

3.2 INSTALLATION UNDER SLAB-ON-GRADE

- A. Install vapor retarder over prepared and compacted base course in accordance with manufacturer's instructions and ASTM E1643.
- B. Lap 6 inches, and tape edges.
- C. Turn up membrane at edges, and secure to foundations or footings with tape.
- D. Seal penetrations of vapor retarder with tape to create air-tight seal between penetrating objects and vapor retarder.
- E. Repair tears and punctures in vapor retarder immediately before concealment by other work. Cover with tape or another layer of vapor retarder.

END OF SECTION

SECTION 07 2620

CONCRETE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Fluid-applied membrane-forming concrete curing and sealing system that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout," and Section 01 7800, "Project Record Documents."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's literature defining system properties, limitations, and application and installation instructions for each system and product.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATION SUBMITTALS

- A. Pre-installation substrate testing reports as required under Section 01 4520, "Concrete Moisture Testing."
- B. Installer qualifications.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturer's extended warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer and meet the following additional requirements.
 - 1. 5 years' experience in installation of floor covering or floor coatings.
 - 2. 3 years' experience in the installation of topical moisture vapor control systems.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

1.8 WARRANTIES

- A. Manufacturer: Furnish District with manufacturer's written 10-year warranty against failure of finish flooring system due to concrete water vapor emission to the installed system. The warranty shall cover all labor and materials needed to replace floor coverings that fail due to moisture vapor emission and moisture born contaminants.
 - 1. Warranty shall not exclude either cracks visible at time of installation or "improper installation" or "inferior concrete."
 - 2. Warranty exclusion shall be limited to:
 - a. Moisture failure due to topical intrusion or plumbing failure or other substances entering from surface.
 - b. Water intrusion due to plumbing leaks below the slab.
 - c. Seismic damage occurring after installation.
 - d. Moisture emission in excess of the warranted limit of the system.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Minimum Performance Requirements:
 - 1. Permeance: 0.56 perms (grains/h/ft²/inch Hg, ASTM E96 water method 73°F/50%RH).
 - 2. Tensile Bond to Concrete: Greater than 200 psi, ASTM D7234.
- B. Sealer shall be compatible with floor covering adhesive.

2.2 MANUFACTURER AND SYSTEM

- A. Curing and Moisture Vapor Emission Control Treatment: Low viscosity, 36 percent solid resin penetrant formulated to control moisture levels when spray applied to freshly poured concrete slabs; "VaporSeal 309" by Floor Seal Technology, or equal.
- B. Post Cure Treatment: 2 component water-based modified epoxy formulation with elastomeric properties; low viscosity treatment that mechanically restricts vapor emission' "MES 100" by Floor Seal Technology, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. A. Examine substrates where work is to be performed. Provide written notification of deficiencies detrimental to proper or timely installation; do not proceed until corrected.

3.2 APPLICATION

- A. Curing Treatment: Apply material as recommended by manufacturer in writing when the surface of the concrete has hardened sufficiently to sustain foot traffic.
 - 1. Coordinate and schedule application of curing treatment with concrete pour schedule as required. Conform to manufacturer's written recommendations.
 - 2. Provide 100 percent coverage of interior floor slabs and concrete decks.
- B. Post Cure Treatment: Verify surfaces to receive post cure treatment meet manufacturer's requirements for application.

1. Application: Apply a minimum of four coats designed to resist a moisture vapor emission rate of 16 pounds in compliance with the manufacturer's written instructions.
 - a. Mask and protect adjacent wall and floor surfaces from effects of scarification and application.
 - b. Scarify slab surface in area of application by shot blasting or other method acceptable to coating treatment manufacturer.
 - c. Prepare and treat cracks, control joints and cold joints per treatment requirements.
 - d. Apply MES 100 with roller or squeegee over entire treatment area; saturate surfaces to ensure a thorough mechanical bond.
 - e. Clean and fill divots, chips, voids and other surface irregularities with 100 percent Portland cement based patching compound or cementitious fill.
2. Cementitious Surfacing: Apply cementitious surfacing over MES100 in areas to receive resilient and carpet floor coverings to facilitate adhesive. Apply at a thickness of 1/8-inch.

3.3 FIELD QUALITY CONTROL

- A. Curing Treatment: Perform calcium chloride testing per ASTM F1869-04 in minimum quantities set forth by the system manufacturer or the flooring manufacturer, whichever is greater.
 1. Each calcium chloride test location to be accompanied by a pH test.
 2. Notify Architect with test results.
- B. Post Cure Treatment: Test areas treated with MES100 per ASTM F1869-04 to ensure Moisture Vapor Emission Rates meet floor covering manufacturer's requirements and the minimum MVER specified herein.
- C. Immediately notify Architect of test results that do not meet the minimum MVER resistance and schedule the application of a minimum of 2 coats or as required to meet the minimum MVER resistance at no additional cost.

END OF SECTION

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SECTION 07 4000

CLADDING SUPPORT SYSTEM

PART 1 – GENERAL

1.1 SUMMARY:

- A. Section Includes:
 - 1. Cladding support system through continuous rigid insulation for exterior walls.
- B. Related Sections:
 - 1. Section 05 4100 "Structural Metal Stud Framing" for exterior and interior structural steel framing members.
 - 2. Section 07 2200 "Roof Board".
 - 3. Section 07 4213 "Metal Wall Panels".

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Provide documentation that cladding support system comply with the CBC and relevant ASTM Standards. Mechanical properties, coatings, dimensions, and labeling are checked. Installation instructions are included.
- B. Provide engineered design and drawings for attachment and back-up framing to support exterior cladding, including number of screw fasteners. Manufacturer's Certification: Submit manufacturer's certification of product compliance with codes and standards along with product literature and data sheets for specified products.
- C. Product Samples: Submit two samples representing actual product for each product specified.
- D. Sustainable Design Submittals:
- E. Mock-Up: Provide a mock-up for evaluation of attachment techniques and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Provide cladding support system by The Steel Network, Inc. (TSN) (<https://www.steelnetwork.com/>) or equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermal Resistance of Exterior Wall Assemblies: Provide thermal performance data (R- and U-values) of the wall assembly that contains the cladding support system through continuous rigid insulation. R- and U-values of the wall assembly must meet requirements of the current ASHRAE code for the geographical zone of the project.
- B. Design loads: Wind pressure and self-weight of cladding as indicated on the project's Architectural/Structural Drawings and as required by the International Building Code.

2.3 CLADDING SUPPORT SYSTEM

- A. Cladding Support System: [ThermaFast®](#) by The Steel Network, Inc.
1. [ThermaFast®](#) is pre-engineered to support weight of rigid insulation, cladding material, and resist wind loads.
 2. [ThermaFast®](#) includes slotted steel material to minimize thermal conductivity, and 1" thermal tape preinstalled on each piece for an integrated continuous thermal break.
 - b. Steel material and coating: ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi(450MPa) minimum tensile strength, 54mil minimum thickness (16-gauge, 0.0566" design thickness) or 33mil minimum thickness (20-gauge, 0.0346" design thickness) with ASTM A653/A653M G90 (Z275) hot dipped galvanized coating.
 - c. Dimensions: As Specified on the Architectural Drawings for 1, 1.5, 2, 3 or 4 inches of continuous rigid insulation layer per design.
 3. [ThermaFast®](#) System Components:
 - a. [ThermaFast® J-Track](#) by The Steel Network, Inc. is used in conjunction with ThermaFast® Z-Track and Corner Angle to secure rigid foam insulation at top and bottom of wall.
 - b. [ThermaFast® Z-Track](#) by The Steel Network, Inc. is used in conjunction with ThermaFast® J-Track and Corner Angle to secure rigid foam insulation. Installed every 24" of rigid foam insulation and incorporates bumps to engage and hold foam in place during installation.
 - c. [ThermaFast® Corner Angle](#) by The Steel Network, Inc. is used in conjunction with ThermaFast® Z-Track and J-Track to secure rigid foam insulation at corners.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, for compliance with requirements and other conditions affecting performance of the work. Do not begin installation until substrates have been properly prepared.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces using the methods recommended by the manufacturer before installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals, and in proper relationship with adjacent construction.
1. Attach cladding support system to steel stud backup with minimum (1) #10-16 self-drilling screws to each stud. (2) screws may be required for high design wind pressures per manufacturer's recommendations.
 2. Attach metal wall panels to cladding support system per cladding panels manufacturer's recommendations.

3. as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

3.4 PROTECTION

- A. Protect installed products until completion of project. repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 4213

METAL WALL PANELS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Metal lap-seam wall panels with exposed fasteners including trim and accessories.
- B. Related Sections:
 - 1. Section 08 1113 Hollow Metal Doors and Frames
 - 2. Section 08 3323 Overhead Coiling Door
 - 3. Section 08 4113 Aluminum Framed Storefronts

1.2 REFERENCES

- A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation
- B. ASTM International:
 - 1. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 792 – Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM A 1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 4. ASTM D 2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 5. ASTM D 4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 - 6. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 8. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - 9. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- C. Underwriters Laboratories (UL):
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
- D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
"Architectural Sheet Metal Manual."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Conduct preinstallation meeting to clarify Project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty.

1.4 ACTION SUBMITTALS

- A. Product Technical Data: For each type of product required, including manufacturer's preparation recommendations, storage and handling requirements, and recommended installation methods.
- B. LEED Submittal Documentation:
 - 1. Product Data for applicable materials and resources credits: Indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Provide a statement indicating cost for each product having recycled content.
- C. Shop Drawings: Showing methods of installation, plans, sections, elevations and details of roof and wall panels, specified loads, flashings, vents, sealants, interfaces with all materials not supplied by the metal panel system manufacturer, and identification of proposed component parts and their finishes. Do not proceed with fabrication prior to approval of shop drawings.
- D. Samples: Selection and verification samples for finishes, colors and textures. Submit two complete sample sets of each type of panel, trim, clip and fastener required.
- E. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.
- F. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.
- G. Mock-up Panel: Provide Panel for verification
 - 1. Size: 8'x8' panel including full assembly & components for complete installation & finishes.
 - 2. Approval of mockup should be reviewed by district & architect for final approval.
- H. Qualifications Statements: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.
- B. Warranty: Warranty documents required in this section.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:

1. Provider of advanced installer training.
 2. Minimum of ten years of experience in manufacturing metal wall panel systems.
 3. Provider of products produced in a permanent factory environment with fixed roll-forming equipment.
- B. Installer Qualifications:
1. At least five years of experience in the installation of metal wall panels.
 2. Experience on at least five projects of similar size, type and complexity as this Project that have been in service for a minimum of two years with satisfactory performance of the wall panel system. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated and who shall be supervised at all times when material is being installed.

1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with manufacturer's current printed product storage recommendations.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage: Store materials above ground, under waterproof covering, protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Provide proper ventilation of metal panel system to prevent condensation build-up between each panel and trim or flashing component. Tilt stack to drain in wet conditions. Remove strippable plastic film before storage under high-heat conditions. Store products in manufacturer's unopened packaging until just prior to installation.
- D. Handling: Exercise caution in unloading and handling metal panel system to prevent bending, warping, twisting and surface damage.

1.8 WARRANTY

- A. Special Exposed Panel Finish Warranty: Manufacturer's standard form PVDF Fluorocarbon System Warranty for film integrity, chalk rating and fade rating in which manufacturer agrees to repair or replace panels that show evidence of deterioration within specified warranty period.
1. Deterioration shall include but is not limited to:
 - a. Color fading of more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling or failure of paint to adhere to bare metal.
 - d. Perforation
 2. Warranty Period: Film integrity for 45 years and chalk and fade rating for 35 years, and perforation for 25 years from date of Substantial Completion.
 3. Manufacturer's warranty may exclude surface deterioration due to physical damage and exposure to salt air environments.

PART 2 – PRODUCTS

2.1 METAL WALL PANELS

- A. Basis of Design: 7/8" corrugated metal panels by Taylor Metal Products: 4566 Ridge Dr NE, Salem, OR 97301 <https://www.TaylorMetal.com>
- B. Acceptable Manufacturers:
 - 1. Metal Sales Manufacturing Corporation: 1326 Paddock Pl, Woodland, CA 95776 <https://www.metalsales.us.com>
 - 2. AEP Span: 10905 Beech Ave, Fontana, CA 92337 <https://www.aepspan.com>
- C. Basis of Design Product:
 - 1. Panel coverage: 34-2/3 inches (880.5 mm).
 - 2. Rib Height: 7/8 inch (22.2 mm).
 - 3. Material: Aluminum-zinc alloy-coated steel sheet, ASTM A 792, AZ50, structural quality, Grade 50, 0.0356 inch (0.904-mm) minimum thickness.
 - 4. Attachment: Exposed direct fastened panel.
 - 5. Rib Configuration: Sinusoidal.
 - 6. Surface Finish: PVDF (Kynar 500).
 - 7. Color:
 - a. Panel Color 1: Ivory (SRI 68)
 - b. Panel Color 2: Sage Green (SRI 31)
 - 8. Fire Resistance Rating: Comply with UL 263.
 - 9. Air Leakage: 0.004 cfm/sq. ft. when tested according to ASTM E 283.
 - 10. Water Penetration: None at 12 psf when tested according to ASTM E 331.
 - 11. Structural Performance: Tested according to requirements of ASTM E 330 and ASTM E 1592.
 - 12. Code and Testing Agency Approvals: Comply with 2017 State of Florida Building Code Approval 9482.1.

2.2 STRUCTURAL PERFORMANCE

- A. Structural Performance Criteria: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, as determined by ASTM E 72 or ASTM E 1592:
 - 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed based on the following Wind Pressure at 32.3 psf
 - 2. Deflection Limits: Shall withstand inward and outward wind design pressures stated in item #1, with maximum deflection of L 1/120 of the span with no evidence of failure.
 - 3. Seismic Performance: Comply with ASCE 7 -16.

2.3 FIELD-INSTALLED THERMAL INSULATION

- A. Refer to division 07 2100 Section "Thermal Insulation"
 - 1. Provide one of the listed insulation types compatible with manufacturer's standard metal panel.

2.4 THERMAL INSULATION

- A. Comply with installation requirements in Division 07 Section "Thermal Insulation." Blanket/Rigid insulation

2.5 MISCELLANEOUS METAL FRAMING

- A. Metal Framing: See Section 05 4100 "Structural Metal Stud Framing Metal Framing".

2.6 CLIPS AND FASTENERS

- A. Clips: Provide clip designed to allow panels to thermally expand and contract, and/or allow air movement (standoff) between the substrate and metal panel:
ZEE Clips: 16 gauge galvanized clip Installed every 24" O.C. of rigid foam insulation.
- B. Fasteners: As recommended by manufacturer for performance indicated.

2.7 ACCESSORIES

- A. Trims and Flashings: Material, metal thickness, and finish to match panels. Profiles indicated in Drawings.
 - 1. Provide manufacturer's standard accessories and other items essential to completeness of wall panel installation.
- C. Panel Penetration Flashing: As recommended by panel manufacturer; designed to provide sufficient movement to prevent creation of points of fixity at penetrations.
- D. Sealant for Field Application: high grade non-curing butyl or curing urethane sealant as recommended by panel manufacturer.

2.8 SOURCE QUALITY CONTROL

- A. Source: Obtain metal wall panels, trim and other accessories from a single manufacturer.
- B. Quality Control: Obtain metal wall panels, trim and other accessories from a manufacturer capable of providing on-site technical support and installation assistance.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Miscellaneous Framing: Install furring, angles, subpurlins, and other miscellaneous wall panel support members and anchorage according to metal wall panel manufacturer's recommendations.

3.2 METAL WALL PANEL INSTALLATION

- A. Install metal wall panels in accordance with approved shop drawings and manufacturer's recommendations. Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement.
- B. Attach panels to metal framing using recommended clips, screws, fasteners, sealants, and adhesives indicated on approved shop drawings.
 - 1. Fasteners for Steel Wall Panels: Stainless-steel for exterior locations and locations exposed to moisture; carbon steel for interior use only.
 - 2. Fasten metal wall panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners.

3. Dissimilar Materials: Where elements of metal wall panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
 4. Accessories: Install trims & flashings according to drawings & manufacturer's recommended details.
- C. Joint Sealers: Install joint sealants where indicated on approved shop drawings.

3.3 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace any installed products that have been damaged.
- C. Clean installed panels in accordance with manufacturer's instructions prior to Owner's acceptance.
- D. Remove and lawfully dispose of construction debris from Project site.

3.4 PROTECTION

- A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 07 6113

STANDING SEAM SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefinished, standing seam sheet metal roofing including associated anchorage and connection devices, flashings, and other components.
 - 2. Drainage mat.
- B. Related Requirements:
 - Sheet Metal Flashing and Trim: Section 07 6200.
 - 1. Flexible Flashing and Underlayment: Section 07 6500.
 - 2. Joint Sealants: Section 07 9200.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout Procedures," and Section 01 7800, "Project Record Documents."

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Plan of each roof showing seam layout and location of unavoidable exposed fasteners.
- B. Product Data: Manufacturer's specifications, data, and installation instructions for roofing system.
- C. Samples: Metal roofing assembly, approximately 24 inches square, in selected color, illustrating material, gage, seaming, and fasteners.
- D. Sustainable Design:
 - 1. Product Data: For adhesives, sealants, fillers and primers, documentation including printed statement of VOC contents to verify compliance with specified limits.
 - 2. Product Test Reports: Documentation verifying metal roofing complies with Solar Reflectance Index requirement and demonstrates a Cool Roof Rating Council (CRRRC) listing.
- E. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Fabricator and installer qualifications.
- B. Verification of conformance with specified structural, seismic, and wind loads.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranties.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Minimum 5 years' experience in sheet metal roofing and approved by roofing material manufacturer.
2. Mechanics: Skilled and thoroughly trained and experienced with the materials, equipment, and methods required in this Section.

B. Mockup:

1. First installed area of sheet metal roofing shall serve as a mockup for review and approval by the Owner's Rep.
2. Mockup shall be a minimum of 3 panels wide and include eave, hip, head, and sidewall condition at applicable to the roof system.

1.7 GUARANTEE AND WARRANTY

- A. Contractor: Furnish District with an extended 5-year guarantee for roofing system installation against defective workmanship and for roof system to remain watertight and weatherproof with normal usage.

B. Manufacturer:

1. System: Furnish Owner with manufacturer's 30 year near "No Dollar Limit" watertight warranty.
2. Finish: Furnish Owner with manufacturer's warranty on finish for 20 years that includes, but is not limited to, the following:
 - a. Will not chip, crack or peel (lose adhesion) but this does not include minute fracturing which may occur in proper fabrication of building parts.
 - b. Will not chalk in excess of ASTM D4214 Number 8 rating, determined by procedure outlines in ASTM D4214.
 - c. Will not change color more than seven Delta-E Hunter units (square root of the sum of square Delta L, Delta a, and Delta b) as determined by ASTM D2244, Method 6.3.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Structural, Seismic, and Wind Loads: Conform to loads specified in the CBC and with UL 580 for Class 90 wind-uplift resistance.
- B. Industry Standard: Conform to applicable provisions of the "Architectural Sheet Metal Manual," as issued by the Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA Manual), latest edition.
- C. Thermal Movement: Provide for noiseless expansion and contraction of components and assemblies caused by an external temperature range of plus 20 degrees F to plus 180 degrees F.
- D. Installation and design of the sheet metal roofing system shall conform to FM Global Property Loss Prevention Data Sheet 1-31, "Metal Roof System."

- E. Roofing system shall have an UL Class A fire rating per UL 790 and tested in accordance with UL 580 test procedures.
- F. Energy Performance: Provide roofing system with initial Solar Reflectance not less than 0.70 when tested according to ASTM C1549 and Thermal Emittance not less than 0.75 when tested according to ASTM C1371 and listed on Cool Roof Rating Council's CRRC-1 Method #1.
 - 1. Energy Performance: ENERGY STAR and Cool Roof Rating Council (CRRC) rated.
 - 2. Packaging shall bear the UL and Cool Roof Rating Council label.

2.2 METAL ROOFING

- A. Manufactured System: Prefabricated, integrated roofing system with factory applied sealant and concealed engineered anchor clips; "R-Mer Span" by The Garland Company, Inc. as specified and the basis of design, or equal.
 - 1. Seam Height: 2-3/8 inch.
 - 2. Panel Width: 18 inches, unless otherwise shown.
 - 3. Panel Texture: Profiled with mesas or minor ribs throughout the pan.
 - 4. Sheet Metal: Specified sheet aluminum, 0.040 inch thick aluminum.
 - 5. Sealant: Factory-applied side lap sealant.

2.3 MATERIALS AND COMPONENTS

- A. Sheet Metal: Aluminum, ASTM B209.
- B. Fastening:
 - 1. Clips: Concealed, galvanized, minimum 18-gauge steel, ASTM A653, Grade A, with G60 coating. Clips shall bear UL 90 imprint.
 - 2. Fasteners:
 - a. Concealed: Manufacturer's standard, non-corroding.
 - b. Exposed: Stainless steel, Type 316.
- C. Sealant Tape: Butyl or neoprene, as recommended by panel manufacturer.
- D. Self-Adhering Sheet Underlayment: 60-mil-thick composite of fiberglass mat and modified rubber compound backed by self-adhesive layer; "Polystick MTS" by Polyglass U.S.A., Inc. as specified, or equal complying with ASTM D1970 and with a service temperature of up to 265 degrees F.
 - 1. Roll Width: Minimum 34 inches.
 - 2. Minimum Exposure Limit: 180 days.
- E. Vent Penetration Flashing: Ethylene propylene diene monomer (EPDM) boot with aluminum reinforcing ring bonded to base flange; "Dektite" by ITW Buildex, "Master Flash," or equal. Provide stainless steel drawband for securing top of vent penetration boot flashing to pipe.
- F. Metal Closures, Rain Drainage, Flashings and Other Sheet Metal: Provide as required for a complete installation finished to match roofing panels.

2.4 FACTORY APPLIED PAINT FINISH

- A. Finish Coat on Exposed Surfaces: Manufacturer's baked-on primer plus shop-applied, 3-coat, high-performance polyvinylidene fluoride (PVDF) coating meeting or exceeding AAMA 2605 weatherability and chemical resistance requirements.
 - 1. Colors: To be selected by Architect.
- B. The back side of the roofing shall receive a 0.25 mil primer and 0.25 mil polyester wash coat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
- B. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking, that tops of fasteners are flush with surface, and that installation is within flatness tolerances required for finished roofing installation.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for drainage, flashings, and penetrations through sheet metal roofing.
- D. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Membrane: Refer to manufacturer's literature for recommendations on installation except where more rigorous requirements are specified.
- B. Install directly over sheathing board perpendicular to slope of roof working from low point to the high point of the roof.
- C. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
- D. Side laps minimum 3-1/2 inches and end laps minimum 6 inches following lap lines marked on underlayment.
- E. Detail all edges and terminations with detailing sealant.
- F. Integrate underlayment with metal flashings as detailed or as required to shed water.

3.3 ROOFING INSTALLATION

- A. Remove protective strippable film prior to installation of panels.
- B. Install roofing system as shown and in conformance with SMACNA and roofing manufacturer's standards, in accordance with reviewed submittals, and to match accepted field mockup.
- C. Maintain visually uniform panel modules and coating appearance.
 - 1. Run roof panels full length parallel to slope. Cross seams are not acceptable.
 - 2. Apply panels sequentially in accordance with panel numbering applied during shop fabrication if numbering method is used to assure uniform appearance of finish coating.
- D. Hem exposed edges of flashing on underside, 1/2 inch.
- E. Fasten cleats and clips securely to substrate. Space cleats and clips as required by sheet metal roofing manufacturer to meet the wind uplift requirements.
- F. Cutting and Fitting:

1. Cut panels neat, square, and true with shearing action cutters. Do not torch or cut with power saw.
 2. Shop fabricate and reinforce openings 6 inches and larger to maintain original load capacity. Reinforce as recommended by system manufacturer.
 3. Field cutting of openings less than 6 inches is acceptable.
- G. Provide closures at eaves and terminations to ensure a watertight assembly.
- H. Dissimilar Metals:
1. Where sheet metal is in contact with dissimilar metals, execute juncture to facilitate drainage and minimize possibility of galvanic action.
 2. At point of contact with dissimilar metal, coat metal with protective paint or tape which can be placed between metals.
- 3.4 CLEANING AND TOUCH-UP
- A. Field touch-up of factory-applied finish will not be allowed unless specifically approved by the Architect. If approved, an acceptable touch-up shall be unnoticeable in completed installation.
- B. Clean finished surfaces in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sheet metal for maintaining weather and water resistance of building enclosure, edge metal, flashing, and trim.
 - 2. Gutters.
 - 3. Manufactured sheet metal accessories.
 - 4. Sealant work related to sheet metal flashing and trim.
- B. Related Requirements:
 - 1. Metal Fabrications: Section 05 5000; steel pipe downspouts.
 - 2. Standing Seam Sheet Metal Roofing: Section 07 6113.
 - 3. Flexible Flashing and Underlayment: Section 07 6500.
 - 4. Joint Sealants: Section 07 9200.
 - 5. Painting and Coating: Section 09 9000.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Closeout Procedures," and Section 01 7836, "Warranties."
- B. Pre-installation Meeting: Prior to installation of sheet metal associated work, Contractor, Architect, and fabricator's field and office representatives responsible for work under this Section shall meet at the Project site to coordinate and discuss sheet metal practices applicable to this Project.
 - 1. Notify participants at least 5 working days before conducting meeting.
 - 2. Record discussions of conference and any conflict, incompatibility, or inadequacy. Furnish a copy of record to each participant.
 - 3. At Contractor's option, agenda for sheet metal discussion may be included as part of pre-installation conferences required for other building assemblies and specified under other Sections.
- C. Coordinate with shop drawing, mockup, and warranty requirements of other Sections installed in conjunction with work of this Section.

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Fully detailed, large-scale drawings for fabrication and installation layout of flashing at existing openings to receive tubular skylights and other custom or unique sheet metal flashing and trim conditions as required for weather tight insulation.
 - 2. Include plans, elevations, and keyed details. Distinguish between shop and field-assembled work.

- B. Products Data: Manufacturer's literature describing self-adhesive flashing, and other manufactured items.
- C. Samples: 6 inch by 12-inch section of typical exposed flashing with shop-applied finish.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Record of pre-installation meeting if not submitted under other Sections.
- B. Sample of manufacturers' warranty for coping system.
- C. Qualification of fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty and guarantee.

1.6 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: At least 5 years documented experience in fabrication and installation of custom flashing and sheet metal of type and scope similar to that required for this Project.
 - 1. Workers shall be skilled and experienced in installing the type of sheet metal specified.
 - 2. Installer shall maintain a full-time supervisor/foreman, fluent in English, at the jobsite during times that sheet metal work is in progress.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged.
- B. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

- A. Verify existing dimensions and details prior to installation of materials. Notify Architect of conditions found to be different from those indicated on the Drawings. Architect will review situation and will inform Contractor and Installer of changes.
- B. Comply with Districts limitations and restrictions for site use and accessibility.
- C. Install materials in strict accordance with safety requirements of material manufacturer, Material Safety Data Sheets, and local, state, and federal rules and regulations.

1.9 GUARANTEE AND WARRANTY

- A. Contractor: Furnish District with an extended written 2-year guarantee agreeing to repair or replace work that leaks and otherwise fails due to defects in workmanship.
- B. Manufacturer: Furnish District with the following written manufacturer warranties:
 - 1. Coping System: Extended 20 year, 110 mph wind warranty.
 - 2. Factory-Applied Coating: 30 year warranty for manufacture for PVDF finish covering color fade, chalk, and film integrity.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Industry Standards:
 - 1. Conform to applicable provisions of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA Manual), except where more stringent requirements are specified or shown.
 - 2. Conform to applicable provisions of NRCA "Roofing and Waterproofing Manual."
- B. Installed flashing and sheet metalwork shall be weathertight. Coordinate with work of other Sections for weathertight installation at interface with other materials and systems.
- C. At roofing applications, comply with specified standards as applicable. Roof edge flashing shall comply with ANSI/SPRI ES-1 and FM 1-90.
- D. Sheet metal flashing and trim shall allow for thermal movement from ambient and surface temperature changes.
- E. Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Completed sheet metal flashing and trim shall not rattle, leak, or loosen.
 - 2. Temperature Change Range: 120 degrees F ambient, 180 degrees F at material surface.
- F. All materials shall be compatible with one another and with other specified materials with which they may come into contact. Promptly bring discrepancies to the attention of the Architect.

2.2 METAL MATERIALS

- A. Metallic-Coat Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, Z275 (G90) coating designation; structural quality.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, Class AZM150 coating designation, Grade 275 (Class AZ50 coating designation, Grade 40); structural quality; "Zincalume," "Galvalume," or "Zintro-Alum" manufactured under license from BIEC International, Inc., Vancouver, WA.
- B. Aluminum: ASTM B209, alloy 3003, 0.032 inch thick, except as otherwise indicated.
- C. Stainless Steel Sheets: ASTM A167 or A176, except as specified, type best suited for purpose.

2.3 ADDITIONAL MATERIALS AND COMPONENTS

- A. Fasteners:
 - 1. Pop rivets, made from same type material as metals to be fastened, may be used for metal-to-metal connections when future disassembly is not required and where not exposed to view.
 - 2. Exposed fasteners shall be finished to match adjacent surface.
- B. Provide stainless steel/EPDM washers at exposed fastener locations.

- C. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
 - 2. For Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by manufacturer of stainless steel sheet.
 - 3. For Lead: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.
- D. Flashing Cement: ASTM D4586, Type II.
- E. Lead Flashing: 4-pound sheet of common desilverized pig lead. Use only at ferrous roof penetrations.
- F. Transition from gutter to Schedule 40 downspouts at gutter openings.
- G. Slip Sheet; if not Indicated on the Drawings:
 - 1. Rosin-sized, unsaturated building paper, 4-6 pounds per 100 square feet; FS UU-B-790, Type I, Grade A.
 - 2. Inorganic, high-performance, non-woven, non-perforated, spunbonded polyolefin; DuPont "Tyvek CommercialWrap."
- H. Draw Bands: Type 316 stainless steel sheet with Type 316 stainless steel screw.
- I. Sealant: As specified in Section 07 9200, "Joint Sealants" and as follows:
 - 1. Exposed Joints: Low modulus, high performance, one-part polyurethane; Type 2.
 - 2. Concealed Joints: Single-component, solvent-release butyl rubber sealant; Type 3.
 - 3. Concealed Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, ton-toxic, non-staining tape 1/2 inch wide x 1/8 inch thick.
- J. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

2.4 MANUFACTURED ACCESSORIES

- A. Manufactured Reglets: 24-gage galvanized steel unless otherwise indicated on the Drawings; Fry Reglet Corp. "Springlok" Flashing System.
 - 1. Finish: Manufacturer's gray epoxy primer; exposed portions shall be field finish painted as specified in Section 09 9000, "Painting and Coating."
 - 2. Provide the manufacturer's following accessories.
 - a. "P" Vinylok Flashing Retainer where counterflashing is not provided by manufacturer.
 - b. Mitered and sealed corners.

2.5 FABRICATION

- A. General:
 - 1. Obtain field measurements for accurate fit before proceeding with shop fabrication.
 - 2. Fabricate cleats and attachment devices from the same material as accessory being anchored.
 - 3. Exposed edges of sheet metal flashing shall be folded and hemmed.
 - 4. Fabricate inside and outside corners, intersections, and complex flashing conditions in shop with folded, constructed, mechanically fastened, and soldered joints.
- B. Shop-fabricate flashing, trim, expansion joints, and similar items to comply with profiles and sizes shown and in accordance with standard details shown in "Architectural Sheet Metal Manual" by SMACNA.
 - 1. Finished work shall be strong and rigid, neat in appearance and free from defects.

2. Surfaces shall be smooth and free from warping or buckling.
 3. Seams and joints shall be kept to a minimum.
 4. Metal sheets in straight runs shall be made up of lengths of not less than 8 feet unless shorter lengths are required to meet thermal expansion requirements.
 5. Joints exposed to view, such as storefront flashing, shall be flush butt joints separated by a 3/8-inch space with backing plate bedded watertight in sealant. Other joints shall be lapped unless otherwise shown on Drawings.
- C. Provide for thermal expansion and contraction and building movement in completed work without overstressing materials, breaking connections, or producing wrinkles and distortion in finished surfaces.
- D. Downspouts and Schedule 40 pipe: Fabricated from specified pipe to profiles shown.
- E. Roof Flashings and Other Locations: Specified metallic-coat steel sheet.

2.6 FINISHING

- A. Factory Finish: High-performance fluoropolymer coating containing minimum 70 percent polyvinylidene fluoride (PVDF) resin and meeting or exceeding AAMA 2605; "Duranar" by PPG Industries, or equal as standard with fabricator.
1. Colors: Custom, as selected by Architect.
- B. Field-finish sheet metal as specified in Section 09 9000, "Painting and Coating."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are smooth and clean to extent needed for sheet metalwork.
- B. Verify that nailers, cants, and blocking to receive sheet metal are installed and suitable to receive sheet metalwork.
- C. Before installing sheet metal, verify shapes and dimensions of surface to be covered.
- D. Notify the Architect of any discrepancies between the Drawings and field conditions, and of any elements that required repair.
- E. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to installer or applicator. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

A. General:

1. Comply with details and profiles indicated on Drawings and SMACNA "Architectural Sheet Metal Manual" recommendations for installation of the work.
2. Coordinate installation with other work that comprises entire system of weatherproofing, waterproofing, and rain drainage.
3. Conceal fastenings, except as otherwise indicated.
4. Conceal reinforcement within finished assembly.
5. Unless otherwise noted, separate dissimilar metals with suitable coating. Coating shall be invisible in finished work, except for ends of sections.
6. Install work watertight, without waves, warps, buckles, fastening stresses, distortion, "oil canning," and true to line and surface, allowing for expansion and contraction.
7. Torch cutting of sheet metal flashing and trim is not permitted.

B. Flashings:

1. Install flashings and counterflashings where shown or required to provide watertight protection.
2. Install specified self-adhesive flashing as specified in Section 07 6500, "Flexible Flashing and Underlayment," under coping and elsewhere as shown.
3. Counterflashing:
 - a. Coordinate installation of counterflashing with installation of roofing membrane termination.
 - b. Extend counterflashing 4 inches over roofing.
 - c. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant.
 - d. Secure in a waterproof manner by means of anchor and washer spaced at 36 inches centers maximum.
4. Pipe or Post Counterflashing Flashing:
 - a. Install counterflashing umbrellas with close-fitting collar with top edge flaired for elastomeric sealant extending minimum of 4 inches over lead flashing or waterproofing membrane.
 - b. Install stainless steel draw band and tighten.
5. Penetration Flashing Through Base Flashing:
 - a. Provide prefabricated collar flashing soldered watertight with minimum 4 inch flanges.

C. Apply sealants as specified in Section 07 9200, "Joint Sealants."

3.3 CLEANING AND TOUCH-UP

- A. Flashings and counterflashings shall be replaced if exposed fasteners or damage exists through the metal flashings and where deterioration or damage is beyond successful repair by finish touchup or similar minor repair procedures.
- B. If applicable, touch up shop-applied primer on galvanized sheet metal, and paint as specified in Section 09 9000, "Painting and Coating."
- C. Clean pre-finished surfaces in accordance with manufacturer's instructions.
- D. Clean and neutralize flux materials. Clean off excess solder.

END OF SECTION

SECTION 07 6500

FLEXIBLE FLASHING AND UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-adhering sheet flashing at perimeter of openings and other locations where required.
 - 2. Self-adhering sheet membrane underlayment at metal roofing.
 - 3. Slip sheet under sheet metal work.
 - 4. Paper underlayment at exterior wall.
- B. Related Requirements:
 - 1. Sheet Metal Flashing and Trim: Section 07 6200.
 - 2. Standing Seam Sheet Metal Roofing: Section 07 6113.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Contract Closeout," and Section 01 7800, "Project Records Documents."
- B. Coordinate with other Sections for continuity of waterproofing of building envelope at interface of flashings and underlayment installed by various trades.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's descriptive data for each proposed product, use limitations, and recommendations for proposed installation.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty.
- B. Installer qualifications.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty as specified.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Regularly engage in the manufacture of self-adhering sheet flashing for at least 10 years, capable of furnishing a list of five satisfactory installations of the material which have been in service for at least 10 years.
- B. Installer: Minimum of 5 years verifiable experience installing the specified materials.

1.7 DELIVERY, HANDLING, AND STORAGE

- A. Store materials away from sparks or flames, protected from rain and physical damage, and within temperature range recommended by manufacturer.
- B. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

1.8 FIELD CONDITIONS

- A. Temperature of air and surfaces to receive underlayment shall be within the range recommended by system manufacturer.
- B. Substrate surfaces shall be dry at application.

1.9 GUARANTEE

- A. Contractor: Furnish Owner with a special written guarantee that the installed systems will be free of defects related to workmanship or material deficiency for a period of 5-years from date of Notice of Completion.
 - 1. The following problems shall be specifically covered under the warranty:
 - a. Cohesive or adhesive failure of the system.
 - b. Weathering deficiencies resulting in failure of the system.
 - c. Abrasion or tear failure of the system resulting from normal use.
 - 2. Guarantee shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Self-Adhering Sheet Underlayment at Metal Roof: 30-mil-thick composite of aggressive butyl rubber based adhesive backed by a layer of high density cross laminated polyethylene; "Grace Ultra" by GCP Applied Technologies, or equal with a service temperature of not less than 265 degrees F and a minimum exposure limit of 60 days.
- B. Sheet Underlayment at Exterior Wall: Asphalt-saturated Kraft paper complying with FS UU-B-790a, Type I, Grade D, Style 2, 60 minute; Jumbo Tex" by Fortifiber Building Systems Group, Inc., or equal. At Contractor's option, two-ply 60 minute "Super Jumbo Tex," or equal, may be used in lieu of two single layers.
- C. Self-Adhering Flashing: 40 mil thick, self-adhesive sheet composed of aggressive butyl rubber based adhesive backed by a layer of high density cross laminated polyethylene; "FortiFlash" by Building Systems Group, Inc., or equal.
- D. Slip Sheet: Inorganic, high-performance, non-woven, non-perforated, spunbonded polyolefin; DuPont "Tyvek CommercialWrap" and related assembly components, or equal.

2.2 ACCESSORIES

- A. Primer for Self-Adhering Membranes: As provided by membrane manufacturer and recommended for each substrate "Fortifiber Primer" by Fortifiber Building Systems Group, Inc., or equal.

- B. Sealant for Flexible Flashing and Underlayment: Single component, fast curing polyurethane; “Moistop Sealant and Liquid Flashing” by Fortifiber Building Systems Group, Inc., or equal acceptable to membrane manufacturer and meeting or exceeding the requirements of ASTM C920 and AAMA 808.3.
- C. Mechanical Fasteners: Washer-type, as recommended by membrane manufacturer for attachment to substrate.
- D. Additional Accessories: Provide as recommended by manufacturer for conditions of installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Where priming is required, prime substrates with primer suitable for each substrate and recommended for this use by membrane manufacturer.
 - 1. Prime only areas that can be covered with membrane on the same day.
 - 2. Re-prime areas not covered with membrane within 24 hours.
- B. At external corners or gaps in sheathing, install liquid membrane to smooth and ease gaps, and to round corners.

3.2 INSTALLATION OF SELF ADHERING FLASHING

- A. Install at locations specified and as shown on Drawings. Coordinate the installation of the self-adhesive membranes with the roofing system to ensure continuity of waterproofing assemblies.
- B. Cut membrane from roll to required lengths, and apply in continuous strips. At vertical surfaces, apply strips vertically. Provide minimum 3-1/2 inches of side lap.
- C. Comply with manufacturer’s recommendations and specified requirements for overlapping at side and end seams.
 - 1. If dimension is not shown on the Drawings, provide minimum 3 inch lap between self-adhesive underlayment and adjacent roofing systems.
 - 2. At perimeter terminations, such as door thresholds, turn up side dams a minimum of 4 inches and fold to form watertight inside corners with seams sealed.
- D. Flashing at Openings: As shown on the Drawings or, if not shown, in accordance with details and recommendations of manufacturer.
 - 1. Fold and lap flashing to prevent water from migrating behind underlayment.
 - 2. Provide sealant at any “pinholes.”
- E. Press membrane into place using initial heavy hand pressure and followed by rolling with a wall or countertop roller.
- F. Patch tears and inadequately lapped seams.
- G. Provide mechanical fasteners where recommended by membrane manufacturer. Fastener heads shall be sealed with liquid membrane.
- H. Inspect membrane for continuity. Patch tears, fishmouths, damage, and inadequately lapped seams in accordance with manufacturer’s instructions.

- I. Apply overlying materials within allowable exposure time limits specified and stated in manufacturer's instructions.

3.3 INSTALLATION OF PAPER UNDERLAYMENT AT WALLS

- A. Apply specified underlayment over sheathing under metal lath as shown.
 1. Securely staple to substrate.
 2. Apply horizontally over entire surface in shingle fashion, lapping courses minimum 3 inches.
 3. Stagger vertical joints.
 4. Stagger joints between layers.
- B. Lap vertical joints minimum 6 inches.
- C. Holes and tears shall be sealed with sealant or tape using products recommended by underlayment manufacturer.

END OF SECTION

SECTION 07 8400

FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Through-penetration firestop systems.
 - 2. Fire-rated joint systems.
- B. Related Requirements:
 - 1. Joint Sealants: Section 07 9200; non-rated sealants.
 - 2. Acoustical Insulation and Sealants: Section 09 8200; non-rated acoustical sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed in accordance with specified requirements.
- C. Sequence work to permit firestopping to be installed after completion of penetrating item installation but prior to covering or concealing of openings.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Manufacturer's UL-approved assembly drawings are acceptable as shop drawings if they reflect actual job conditions. For job conditions where no clearly defined UL-approved assembly exists, provide an engineering judgment from manufacturer. Engineering judgments shall follow requirements set forth by the International Firestop Council and shall be acceptable to authorities having jurisdiction.
- B. Product Data: Manufacturer's specifications and installation instructions for all materials and prefabricated devices, providing descriptions sufficient for identification at the jobsite. Instruction details shall reflect actual job conditions.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's certification or certified laboratory test report stating that materials or combination of materials meet requirements specified in ASTM E814 and are so classified in UL's Building Materials Directory.
- B. UL Certificates of Compliance.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Having the necessary experience and training to install manufacturer's products in accordance with specified requirements. Manufacturer's willingness to sell its

through-penetration firestop system products to Contractor or to installer engaged by Contractor does not in itself confer qualification.

- B. Installation Responsibility: Assign installation of through-penetration firestop systems in Project to a single qualified installer or verify that installers retained by subcontractors conform to specified qualifications.
- C. Regulatory Requirements:
 - 1. Firestopping installation shall meet requirements of UL Test UL 1479, "Fire Tests of Through-Penetration Firestops," or ASTM E814 and ASTM E119.
 - 2. Materials shall be listed and approved by local building department for intended use.
 - 3. Materials shall meet requirements of NFPA 101, "Life Safety Code" and NFPA 70, "National Electrical Code."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened packages or containers clearly identifying manufacturer's names, brand designations, product descriptions, applicable standards, lot numbers, and test or rating labels.
- B. Comply with manufacturer's recommendations for handling, storage, and protection during installation.
- C. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

1.7 FIELD CONDITIONS

- A. Provide masking and drop cloths during installation to prevent firestopping materials from contaminating adjacent surfaces.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE CRITERIA

- A. General:
 - 1. Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and passage of smoke and other gases.
 - 2. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84.
 - 3. Materials shall be compatible with each other and with other specified items with which they may come in contact and shall not cause corrosion of penetrating items.
 - 4. Materials shall be free of solvents, asbestos, or PCBs, and shall be nontoxic to human beings at all stages of application and during fire conditions.
 - 5. Firestopping shall remain sufficiently flexible after installation to accommodate expected vibration and movement between penetrating items and rated building components or assemblies or between adjacent building components or assemblies at joint systems, without affecting adhesion or integrity of system.
 - 6. Caulk, foam, mortar, and putty materials shall be autobonding to permit changes to penetrating items.
 - 7. Rating of firestopping materials or system shall in no case be less than rating of rated floor or wall assembly.

- B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings as determined in accordance with ASTM E814 but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined in accordance with ASTM E814, where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. Locations where T-rated assemblies are required include, but are not limited to, where penetrating items are larger than a 4-inch-diameter nominal pipe or 16 square inches in overall cross-sectional area.
- D. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/square foot at both ambient temperatures and 400 degrees F.
- E. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- F. For firestopping exposed to view, moisture, and physical damage, provide assemblies that do not deteriorate when exposed to these conditions.

2.2 FIRESTOPPING MATERIALS

- A. General:
 - 1. Materials listed below are not necessarily all-inclusive, nor are all materials listed necessarily required to be used.
 - 2. Manufacturers: As listed under each product, 3M Fire Protection Devices, or equal.
 - 3. Contractor shall develop systems for firestopping using approved systems from a selected single manufacturer unless products for required systems are not available from the selected manufacturer.
- B. Job-Mixed Vinyl Compound: "USG Firecode Compound" by United States Gypsum Co., "Gold Bold Sta-Smooth FS 90 Fire-Shield Compound," or equal.
- C. Firestop Mortar: Prepackaged dry mix of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar; Hilti FS 637 "Firestop Mortar," or equal.
- D. Non-intumescent Firestop Sealant: One-part silicone elastomer; Hilti CP 601S "Elastomeric Firestop Sealant," or equal.
- E. Intumescent Firestop Sealant: Hilti "FS-One," or equal.
- F. Mastic Firestop Sealant: Single component, water based, mastic grade; Rectorseal "Metacaulk 1100" or equal.
- G. Firestop Foam: Two-component silicone elastomer; Hilti CP 620 "Fire Foam," or equal.
 - 1. Forming and Damming Materials, As Required: Mineral fiberboard or as selected by installer.
 - 2. Primer, sealant, and solvent cleaner as recommended by foam manufacturer.
- H. Intumescent Fire Blocks: Hilti "FS-657" or equal.

- I. Flexible Firestop Spray Coating: Sprayable water-based coating; designed to form a flexible seal over mineral fiber firesafing; Hilti CP 672 "Speed Spray," or equal.
- J. Intumescent Putty and Putty Pads (for Use at Electric Boxes): Hilti CP 617 "Firestop Putty Pads" in required lengths and CP 618 "Firestop Putty Sticks," or equal.
- K. Intumescent Pipe Wrap: Hilti CP 645, 648E or 648S "Firestop Wrap Strip," or equal.
- L. Electrical Box Treatment: 3M "Fire Barrier Moldable Putty Pads," Hevi-Duty Nelson Products "FSP Firestop Putty Pads," International Protective Coatings Corp. "Flamesafe FSP 1077 Firestop Pads," or equal.

2.3 FIRESAFING, ACCESSORIES, AND ADDITIONAL MATERIALS

- A. Types:
 - 1. Unfaced Mineral Fiber: 4 pcf, suitable for friction fit in voids. Melt point 2000 degrees F minimum, ASTM C24. Ceramic or cementitious-blend fiber is also approved. Do not use glass fiber.
 - 2. Foil Faced Mineral Fiber: Same as unfaced mineral fiber but with aluminum foil facing on one side.
 - 3. Thermal Conductivity: 0.25 to 0.23 k-value per ASTM C518.
 - 4. Flammability:
 - a. Noncombustible as defined by NFPA Standard 220 when tested in accordance with ASTM E136.
 - b. Surface-Burning Characteristics:
 - 1) Flame Spread: 15 (10 to 25 with foil facing).
 - 2) Fuel Contributed: 0 (5 with foil facing).
 - 3) Smoke Developed: 0.
- B. Other Facing and Backing Materials: As recommended by firestopping manufacturer. Use fire resistive material where possible.

2.4 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backing materials, forms, clips, and other items as required to hold firestopping and firesafing in place.
- B. Prepare surfaces and install firestopping sealants in accordance with ASTM C1193 and manufacturer's printed instructions, except where more stringent requirements are shown or specified. Exposed sealant shall be trowelled smooth.
- C. Firestopping and firesafing shall be installed to completely fill void spaces regardless of geometric configuration and to maintain integrity over entire area to form a continuous fire stop. Do not use unfaced mineral fiber by itself for firestopping purposes.

- D. Firestop wall penetrations on both sides.
- E. At sound-rated fire-rated construction, use only permanently resilient firestopping materials, and seal airtight.
- F. Exposed sealant shall be troweled smooth.

3.2 ELECTRICAL BOXES AND UTILITY OUTLETS

- A. Steel electrical outlet boxes on opposite sides of walls requiring protected openings shall be separated by a horizontal distance of 24-inches.
- B. Steel electrical outlet boxes which occur in combination with outlet boxes of any size such that the aggregate area of unprotected outlet boxes exceeds 100-square inches in any 100-square feet of wall area shall be protected by an approved material or detail to decrease the aggregate area of unprotected utility boxes to less than 100-square inches in any 100-square feet of wall.
- C. Steel electrical outlet boxes which exceed 16-square inches in area shall be protected with specified electrical box treatment.
- D. Utility and electrical outlets or boxes shall be securely fastened to the stud or framing of the wall or ceiling assembly.
 - 1. The opening in the gypsum board shall be cut so that the clearance between the box and the gypsum board does not exceed 1/8-inch.
 - 2. In smoke partitions, fill the 1/8-inch gap with an approved fire-rated sealant.

3.3 FIELD QUALITY CONTROL

- A. Firestopping shall remain accessible until inspection and approval by governing authorities.

END OF SECTION

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior sealants and caulking work required to weatherproof the building at locations modified under this Contract.
 - 2. Interior sealants and caulking.
- B. Related Requirements:
 - 1. Glazing: Section 08 8000; glazing sealants.
 - 2. Acoustical Insulation and Sealants: Section 09 8200; acoustical sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications, recommendations, and installation instructions, including cleaning of joint surfaces, for each sealant material to be used.
- B. Samples: Color selection for each product exposed to view; manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.3 INFORMATIONAL SUBMITTALS

- A. Statement of qualifications for applicator of exterior sealant, if requested by Architect.
- B. Sample copy of manufacturer's warranties stating obligations, remedies, limitations, and exclusions of warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Extended warranty.
- B. Manufacturer's written instructions for recommended maintenance practices, including schedule.

1.5 QUALITY ASSURANCE

- A. Material Compatibility: Sealant materials shall be compatible with one another and with other specified materials, under conditions of service and application required.
- B. Source Limitations: Obtain each kind of joint sealant from a single source manufacturer.
- C. Installer Qualifications for Exterior Sealants: A firm experienced in installing sealants similar to that those indicated for this Project, with a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with manufacturer's labels. Labels on delivered materials shall show manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.7 FIELD CONDITIONS

- A. Do not proceed with sealant installation under adverse conditions such as when ambient or substrate conditions are outside limits recommended by manufacturer, wet substrates, joint widths are not within tolerance, or contaminants have not been removed from substrates.
- B. Verify existing dimensions and details prior to installation of materials. Notify Architect if conditions are found to differ from those indicated on the Drawings or are at variance from sealant manufacturer's recommendations.

1.8 GUARANTEE AND WARRANTY

- A. General:
 - 1. Repair or replace joint sealants that fail to achieve airtight and watertight seal or otherwise fail to perform as intended because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining, loss of adhesion or cohesion, or do not cure within the specified warranty periods.
 - 2. Extended warranties specified in this Section exclude deterioration or failure of joint sealants from the following:
 - a. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - b. Disintegration of joint substrates from natural causes exceeding design specifications.
 - c. Mechanical damage caused by individuals, tools, or other outside agents.
 - d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
- B. Contractor: Furnish District with a written 2-year guarantee agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
- C. Manufacturer: Furnish District with manufacturer's written 20-year warranty for sealant Types JS-1A and JS-1B agreeing to furnish sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty shall include failure due to loss of adhesion, weather seal. In addition, Type JS-1B sealant warranty shall include staining.
 - 2. Contractor shall be responsible for scheduling, arranging, and providing any print review and testing required by manufacturer as a condition for issuance of its warranty.

PRODUCTS

1.9 SEALANT MATERIALS

- A. Colors:
 - 1. Concealed Material: Any of manufacturer's standard colors.
 - 2. Exposed Material: Manufacturer's standard colors, to be selected.
- B. JS 1A - Sealant for General Exposed Exterior Use: One part, neutral cure, gun-grade silicone complying ASTM C920 Type S, Grade NS, ASTM C1193; "790," 791," or "795" by Dow Corning Corporation, "Spectrem II" or "Spectrem III" by Tremco, "895" by Pecora Corporation, or equal.
- C. JS 1B - Sealant for Use at Concrete and Other Porous Surfaces: One part, medium modulus, silicone polymer conforming to ASTM C920, Type S, Grade NS, Class 50 and formulated to reduce or eliminate dirt pickup, surface streaking, and substrate staining; Dow Corning "756 SMS," "SCS9000 SilPruf NB" by Momentive Performance Materials, or equal.
- D. JS 2 – Traffic Grade Sealant at Exterior and Interior Small to Medium Width Joints: One-part, self-leveling, traffic grade polyurethane conforming to ASTM C920, Class 25, Type S, Grade P; Pecora "NR-201," or equal..
- E. JS 3 - Exposed Sealant at Metal Flashing: Single-component, polyurethane conforming to ASTM C920, Type S, Class 25, Grade NS; Sika "Sikaflex 15LM," or equal, acceptable to metal panel manufacturer.
- F. JS 4 - Concealed Bedding Conditions: One-part butyl-rubber calk conforming to FS TT-S-001657, Type I.
- G. JS 5 - Interior Nonwet Areas: One-component, acrylic-latex, water-based sealant conforming to ASTM C834; Tremco "Acrylic Latex," Pecora "AC-20," or equal.
- H. JS 6 - Interior Wet Areas: One-part mildew-resistant silicone rubber conforming to ASTM C920, Type S, Grade NS, Class 25; GE "Silicone II Kitchen and Bath," Dow Corning "8640," or equal.

1.10 MISCELLANEOUS SEALANT MATERIALS

- A. Sill Sealer: 3/8-inch thick closed cell polyethylene foam with a self-adhering waterproof membrane facing; "Protector Premium Energy Sill Sealer" by Protecto Wrap Company, or equal.
- B. Perimeter Gap Sealant: Gun-dispensed, aerosol foam polyurethane or polyisocyanurate type conforming to ASTM C1620; Hilti "CF 810/812," or equal.
- C. Fiber Expansion Joint Material: Preformed cellular fiber complying with ASTM D1751, 1/2 inch thick unless otherwise noted; "SealTight Fiber Expansion Joint Filler" by W.R. Meadows, or equal.
- D. Additional Sealant Materials: As specified in the respective Specification Sections.

1.11 SEALANT ACCESSORIES

- A. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

- B. Sealant Backer Rod: Compressible rod-stock polyethylene foam, nongassing, polyethylene-jacketed polyurethane foam, butyl-rubber foam, neoprene foam, or other flexible, permanent, durable, nonabsorptive closed cell material as recommended for compatibility with sealant by sealant manufacturer.
- C. Cleaner for Nonporous Surfaces: Provide nonstaining chemical cleaner or type acceptable to manufacturer of sealer and backing materials which is not harmful to substrates and adjacent nonporous materials.
- D. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.
- E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer. Provide self-adhesive tape where applicable.

PART 2 - EXECUTION

2.1 EXAMINATION AND PREPARATION

- A. Verify that joint dimensions are not less than or greater than recommended by joint sealer manufacturer for application indicated.
- B. Clean joint surfaces immediately before installation of sealant.
 - 1. Remove dirt, insecure coatings, moisture, and other substances that would interfere with bond of sealant.
 - 2. Etch concrete joint surfaces as recommended by sealant manufacturer.
 - 3. Use cleaning solvent to clean all joint surfaces. Do not permit solvent to air dry
 - 4. Wipe joints free of solvent, using clean, dry cotton cloths or lintless paper.

2.2 INSTALLATION OF ELASTOMERIC SEALANTS

- A. General:
 - 1. Comply with manufacturer's printed instructions, except where more stringent requirements are shown or specified.
 - 2. Comply with ASTM C1193 for installation of elastomeric joint sealants.
- B. Prime or seal joint surfaces as recommended by sealant manufacturer.
 - 1. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
 - 2. Prime anodized aluminum and painted surfaces using primer recommended by sealant manufacturer, unless sealant manufacturer certifies in writing, that primer is not required.
- C. Install sealant backer rod for elastomeric sealants, except where recommended to be omitted by sealant manufacturer for application shown.
- D. Install bond-breaker tape wherever backer rod is not used and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.
- E. Use only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.
 - 1. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces.
 - 2. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

2.3 INSTALLATION OF ADDITIONAL SEALING MATERIALS

- A. Install sill sealer on top of foundation walls under sill plate to close gaps between concrete and sill plate.
- B. Aerosol Foam: Install at exterior wall crevices, penetrations and cracks in accordance with manufacturer's instructions. Fill spaces completely to a uniform monolithic density without voids.

2.4 CLEAN AND CURE

- A. Clean adjoining surfaces to eliminate excess sealant.
- B. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

END OF SECTION

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SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hollow metal doors and frames.

- B. Related Requirements:
 - 1. Flush Wood Doors: Section 08 1416.
 - 2. Door Hardware: Section 08 7100.
 - 3. Glazing: Section 08 8000.
 - 4. Painting and Coating: Section 09 9000.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000 "Contract Closeout" and Section 01 7800, "Project Records Documents."

- B. Coordination: Hardware supplier shall furnish steel door and frame manufacturer with accepted hardware schedule, hardware templates, and samples of physical hardware where necessary to ensure correct fitting and installation. Preparation includes sinkages and cutouts for mortise and concealed hardware.

1.3 ACTION SUBMITTALS

- A. Schedule and Shop Drawings:
 - 1. Cover each type of door, frame, and frame condition.
 - 2. Include the following specific information:
 - a. Elevation of doors and frames.
 - b. Jamb and head details.
 - c. Hardware preparation locations and reinforcing details of doors and frames.
 - d. Door and frame location schedule.
 - e. Complete door and frame descriptive nomenclature.
 - f. Material description and gages.
 - g. Meeting stile details.
 - h. Methods of anchorage.
 - i. Glass molding details.
 - j. Louver details.
 - 3. Use same reference numbers for details and openings as those indicated on Drawings.

- B. Product Data: Manufacturer's technical data describing doors and frames to be provided.

- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Test Reports for each type of fire-rated hollow metal door and frame assembly if not included as part of product data submittal.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty as specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide packaging as cardboard or other containers, separators, banding, spreaders, and paper wrappings in order to protect items during transit and Project site storage.
- B. Inspect products upon delivery for damage. Minor damage may be repaired, provided that refinished items are equal in all respects to new work and acceptable to the Architect. Otherwise, remove and replace damaged items as directed.
- C. Store doors upright in a protected dry area on a raised platform at least 1 inch off the ground. Provide blocking between units so as to provide air circulation.
- D. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

1.7 FIELD CONDITIONS

- A. Post-Set Frames: Prepared openings shall be properly located and sized, plumb and square. Do not force-fit frames into improperly constructed openings.
- B. Preset Frames: Wall/partition and frame locations shall be accurately marked before frames are erected.

1.8 WARRANTY

- A. Manufacturer: In addition to the Contractor's Contract warranty, furnish District with manufacturer's warranty for doors and frames against defects in materials and workmanship including twisting, buckling or warping. Warranty shall cover replacement of door plus costs of hanging and finishing.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Steel doors and frames shall comply with ANSI A250.8.
- B. Work shall meet applicable requirements of the Hollow Metal Manufacturers Association (HMMA), a Division of the National Association of Architectural Metal Manufacturers (NAAMM).
- C. Fire-Rated Assemblies: Provide fire-rated steel doors and frames investigated and tested as part of a fire door assembly complete with type of fire door hardware to be used.
 - 1. Identify each fire-rated door and frame with permanent, metal labels, in accordance with NFPA Standard 252, UL 10C, and CBC, from approved testing and inspection agency, indicating applicable fire rating.

2. Fire rated assemblies shall be protected by tight fitting smoke and draft control assemblies and include door and frame with fire rating label followed by a letter "S" for smoke and draft control rating.
 3. Construct and install assemblies in such a manner as to comply with NFPA Standard No. 252, or UL 10C and NFPA 80 and as specified herein.
 4. Labels: Place fire rating labels where visible when doors and frames are in installed, open positions.
 5. Pairs of doors with vertical-rod panic exit devices shall be labeled without use of overlapping astragals.
 6. Fire Ratings: Refer to Drawings for fire rating requirements.
- D. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by an approved testing and inspecting agency based on testing according to NFPA 257 or UL 9.

2.2 MANUFACTURERS

- A. Steel Doors and Frames: Ceco Door, an ASSA ABLOY Group Company, Steelcraft or Republic Doors and Frames by Allegion, or equal SDI Certified manufacturer.

2.3 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A568 and ASTM A1011.
- B. Cold-Rolled Steel Sheets: Commercial-quality carbon steel complying with ASTM A568 and A1008, exposed, matte finish, oiled.
- C. Galvanized Steel Sheets: Commercial-quality zinc-coated carbon steel complying with ASTM A653 with A60 or G60 zinc coating.
- D. Supports and Anchors: Fabricated of not less than 18-gage galvanized sheet steel.
- E. Frame Anchors:
1. Typical: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 2. Anchors Built into Exterior Walls: Steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.
- F. Inserts, Bolts, and Fasteners: Manufacturer's standard units.
- G. Shop-Applied Paint: Rust-inhibitive primer, either air dried or baked on, suitable as a base for specified finish paints.

2.4 FABRICATION - GENERAL

- A. Conform to requirements of SDI or NAAMM.
- B. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.
- C. Fabricate steel doors and frames to required profiles and sizes by forming with edges straight and sharp.

- D. Exterior doors and frames shall be fabricated from specified galvanized-steel sheets.
- E. Fit and fabricate accurately with corner hairline joints and all surfaces free from warp, wave, buckle, and other defects.
- F. Welding:
 - 1. In accordance with AWS standards for high-grade hollow metal work.
 - 2. Grind exposed beads smooth.
- G. Fabricate exposed faces of doors only from cold-rolled steel.
- H. Fabricate frames from either cold-rolled or hot-rolled steel (at fabricator's option).
- I. Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.
- J. Shop Painting: Comply with ANSI/SDI A250.10.

2.5 STEEL FRAMES

- A. Gages:
 - 1. Interior:
 - a. Frames in Openings 4'-0" or Less in Width: 16 gauge unless thicker gage is included in UL test procedure for rated frames.
 - b. Frames in Openings over 4'-0" Width: 14 gauge.
 - 2. Exterior: 14 gauge.
- B. Design and Construction:
 - 1. Factory-assembled and weld into a single unit by frame manufacturer. Saw-miter or cope and tab frame miters, and continuously weld at return, face, rabbet, and stop. Knocked-down frames will not be accepted.
 - 2. Jamb depths, trim, profile and backbends shall be as shown on Drawings.
 - 3. Minimum depth of stops shall be 5/8 inch unless otherwise noted. Drill stops for silencers: three in strike stops for single swing doors, two in head stops for double swing doors.
 - 4. Profile bottom of jamb to contour of concrete at change in floor elevation occurring within jamb width.
 - 5. Floor Anchors:
 - a. Floor anchors shall be securely welded inside each jamb for floor anchorage.
 - b. Where required, provide adjustable floor anchors, providing not less than 2 inch height adjustment.
 - c. Minimum thickness of floor anchors shall be 14 gauge.
 - 6. Jamb Anchors:
 - a. Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to 7'-6" High: 4 anchors.
 - 2) Frames 7'-6" to 8'-0" High: 5 anchors.
 - 3) Frames over 8'-0" High: 5 anchors plus one additional for each 2 feet or fraction thereof over 8'-0" inches.
 - b. Provide ceiling struts for fire rated frames where required by ANSI/UL 63.
 - 7. Frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

2.6 HOLLOW METAL DOORS

- A. ANSI/SDI Classification:
1. Exterior: Level 3 and Physical Performance Level A, Model 2, extra heavy-duty seamless construction.
 - a. Face sheets shall be minimum 0.053 inches (16 gage).
 - b. Insulated, steel stiffened, for a minimum "U" value of 0.24 except where opening into unconditioned spaces.
 2. Interior Non-Fire-Rated: Level 2 and Performance Level B, Model 2, heavy-duty seamless construction.
 - a. Face sheets shall be minimum 0.042 inches (18 gage).
 - b. Core: Honeycomb or polystyrene, laminated to the inside of both face sheets.
 3. Interior Fire-Rated: Level 2 and Performance Level B, Model 2, seamless construction.
 - a. Face sheets shall be minimum 0.042 inches (18 gage) unless otherwise required for required rating.
 - b. Core: Mineral fiber or as standard with manufacturer to meet scheduled fire rating.
 - c. Rating: As scheduled.
 4. Provide Level 3 and Physical Performance Level A, Model 2, extra heavy-duty seamless construction at interior doors if scheduled at Toilet Rooms, Storage, and Utility Rooms.
- B. Provide astragals extending full door height on active leaf of pairs of exterior service doors.
- C. Louvers shall be full welded and factory installed.
- D. The top and bottom of out-swinging exterior doors shall be closed with either a flush or inverted channel cap, welded, filled, and finished smooth to provide protection from entry of water inside door.
- E. Glass: As specified in Section 08 8000, "Glazing."

2.7 DOOR ACCESSORIES

- A. Non-Rated Louvers: Stationary non-vision, 1-inch thick; with security grille; Model PLSL by Anemostat Door Products, or equal.
1. Face Plate: Removable 12 gauge cold rolled steel lattice and security grille with 13/16 inch square holes on 1 inch centers.
 2. Louver Blades: 18 gauge cold rolled steel.
 3. Provide manufacturer's zinc plated galvanized material at exterior locations.
 4. Provide manufacturer's galvanized wire insect screens at exterior locations.
 5. Finish: Manufacturer's standard primer and field painted to match door color.
 6. Fasteners shall be located on secure side of door.
- B. Rated Louvers: Stationary non-vision blade type, 1-inch thick, with security grille, fusible link, and operating lever; Model FLDL-UL-SG by Anemostat Door Products, or equal.
1. Materials: 18-gauge steel blades and frame.
 2. Finish: Manufacturer's standard primer and field painted to match door color.
 3. Fasteners shall be located on secure side of door.
 4. Frame shall be fire tested with UL and WHI mark to match rating of door.
- C. Vision Frames: 20 gauge (0.042 inch, 1.0 mm) cold rolled steel, low profile, two-piece with mitered and welded corners with counter-sunk mounting holes for flush assembly; "LoPro" by Anemostat, or equal.
1. Finish: Manufacturer's standard primer and field painted to match door color.
 2. Size: As indicated on the Drawings and to receive scheduled glass thickness.

3. Frame shall be fire tested with UL and WHI mark at fire-rated doors where noted in door schedule.

2.8 FINISH HARDWARE PREPARATION

- A. Prepare hollow metal units to receive finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with Finish Hardware Schedule and templates provided by hardware suppliers. Preparation includes sinkages and cut-outs for mortise and concealed hardware.
- B. Provide minimum gage hardware reinforcing in accordance with Table IV of ANSI A250.8 and the following additional requirements.
 1. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware only in accord with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware (or hardware, the interrelation of which is to be adjusted upon installation - such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates.
 2. Minimum gages for hardware reinforcing plates shall be as follows:
 - a. Hinge and Pivot Reinforcement: 7 gauge.
 - b. Reinforcement for Lock Face, Flush Bolts, Concealed Holders, Concealed or Surface Mounted Closers: 12 gauge.
 - c. Reinforcements for All Other Surface Mounted Hardware: 16 gauge.
 3. Interior Hollow Metal frames at 60-Minute Fire Rated Openings: Meet manufacturer's specifications for indicated level of fire rating.
- C. Comply with applicable requirements of ANSI/BHMA A156.115.
- D. Locate finish hardware as shown on final shop drawings in accordance with locations noted herein.
- E. Provide reinforcements for both concealed and surface applied hardware:
 1. Drill and tap mortise reinforcements at factory, using templates.
 2. Install reinforcements with concealed connections designed to develop full strength of reinforcements.
- F. Labeled Doors and Frames: Refer to Section 08 7100, "Door Hardware" for mounting heights of hardware on doors and frames, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION OF FRAMES

- A. Install frames in accordance with ANSI/SDI A250.11.
- B. Exercise care in setting of frames in order to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.
- C. Secure anchorages and connections to adjacent construction.
 1. Provide not less than three anchors and one floor clip per side for doors up to 7 feet high and four anchors and one floor clip per side for doors over 7 feet high.
 2. Frames over 36 inches wide shall have one anchor at head.
 3. Anchors shall be furnished to suit wall conditions and floor angles or clips welded to frame for fastening to floor.

- D. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached. Do not use shipping bars as spreaders.
- E. Allow for expansion movement as required.
- F. Install fire-rated frames in accordance with NFPA Standard No. 80.
- G. Frames at sound-rated doors shall be filled with mineral wool insulation conforming to the requirements of Section 09 8200, "Acoustic Insulation and Sealants."

3.2 INSTALLATION OF DOORS

- A. Install steel doors in accordance with manufacturer's instructions and Project requirements.
- B. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.
- C. Do not erect members that are observed to be warped, bowed, deformed, or otherwise damaged or defaced to such extent as to impair strength or appearance. Remove and replace members that have been damaged in process of erection.
- D. Apply hardware in accordance with requirements specified in Section 08 7100 "Door Hardware."
- E. Adjust operable parts for correct function.

3.3 ADJUST AND CLEAN

- A. Prime Coat Touch-up: Immediately after erection, items with damaged prime coat shall be sanded smooth and touched up with same primer as applied at shop.
 - 1. Remove rust before above-specified touch-up is applied.
 - 2. Touch-up shall not be obvious after application of finish coats.
- B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel items undamaged and in complete and proper operating condition.
- C. Hollow metal frames or doors which are defective, have hardware cutouts of improper size or location, or which prevent proper installation of doors, hardware or work of other trades, shall be removed and replaced with new at no additional cost to District.

3.4 PROTECTION

- A. Protect installed work against damage from other construction work and until ready to receive final finish painting as specified in Section 09 9000, "Painting and Coating."

END OF SECTION

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SECTION 08 1416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood flush doors.
 - 2. Factory preparation for finish hardware.
 - 3. Factory finishing.

- B. Related Requirements:
 - 1. Hollow Metal Doors and Frames: Section 08 1113.
 - 2. Door Hardware: Section 08 7100.
 - 3. Glazing: Section 08 8000; glass and glazing.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Closeout Procedures," and Section 01 7836, "Warranties."

1.3 ACTION SUBMITTALS

- A. Shop Drawings and Schedule: Include the following:
 - 1. Opening-identifying symbol. Use same identification as Door Schedule on Drawings.
 - 2. Location and sizes of each door.
 - 3. Elevation of each kind of door.
 - 4. Swing.
 - 5. Glazing and louvers.
 - 6. Location and extent of any required hardware blocking.
 - 7. Special beveling.

- B. Product Data: Manufacturer's specifications for each type of wood door proposed for use on this Project. Indicate door core and edge materials and construction; veneer species, type, and characteristics; louvers and vision lights; and factory finishing and machining criteria.

- C. Samples: Door construction, 12 inches square minimum, cut from top or bottom corner of door to illustrate core and face veneer.

- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Executed warranty.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain wood doors from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors at factory prior to shipping, using manufacturer's standard method.
- C. Label and identify doors for each opening to facilitate proper location using temporary, removable, or concealed markings. Correlate door identification with designation system used on shop drawings.
- D. Store doors flat on level surface in clean, dry, and properly ventilated spaces. Do not expose doors to abnormal heat, dryness, and humidity.
- E. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 WARRANTY

- A. Manufacturer: Furnish District with manufacturer's written agreement on door manufacturer's standard form signed by manufacturer, installer, and Contractor, agreeing to repair or replace defective doors which warp (bow, cup, or twist), which show telegraphing of core construction in face veneers, or which do not conform to tolerance limitations of specified quality standards.
 - 1. Warranty Period: Lifetime of the original installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Accepted Manufacturers:
 - 1. Eggers: www.eggersindustries.com.
 - 2. Haley Brothers: www.haleybros.com.
 - 3. Marshfield Door Systems: www.marshfielddoors.com.
 - 4. or equal member of WI, AWI or WDMA.

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. Except as otherwise specified or standard with manufacturer, doors shall be manufactured in accordance with Section 9 of the "North American Architectural Woodwork Standards (NAAWS)," published jointly by WI and AWMAC, and referenced WDMA Standards where noted.
- B. Allowable Tolerances for Fabrication of Doors: In accordance with referenced NAAWS standard.

2.3 FABRICATION - GENERAL

- A. Conform to requirements of regulatory agencies, NAAWS and WDMA standards, reviewed shop drawings, and Contract Documents.
- B. Thickness: 1-3/4 inch, unless otherwise noted.
- C. Sizes: As shown on the Drawings. Coordinate with installation to determine actual sizes and clearances.
- D. Factory-cut openings, insofar as practicable. Seal raw edges immediately after cutting and fitting, including areas routed for hardware.
- E. Prefit and premachine doors. Coordinate preparation of doors with hardware requirements specified in 08 7100, "Door Hardware." Comply with the tolerance requirements of NAAWS or WDMA for prefitting.
- F. Undercut doors where indicated or required by submittals.
- G. Seal raw edges immediately after cutting and fitting, including areas routed for hardware.
- H. Glass: As noted on the Drawings for each door Type and specified in Section 08 8000, "Glazing."
- I. Provide door clearances in accordance with the WDMA Standard and as follows.
 - 1. For non-rated doors provide clearances of 1/8 inch at jambs and heads, and 1/4 inch from bottom of door to top of floor finish, unless otherwise indicated on Drawings.
 - 2. When threshold is shown or scheduled, provide 1/8 inch clearance from bottom of door to top of threshold.
 - 3. Modify clearances as required for specified seals.

2.4 FLUSH WOOD DOORS

- A. Door Appearance Grade: Custom.
- B. Performance Duty Levels (WDMA): Extra Heavy Duty.
- C. Cross Banding: Hardwood veneer, 1/16 inch thick.
- D. Vertical Exposed Edges of Stiles: Solid hardwood.
- E. Cores:
 - 1. Typical: Solid, 5-ply, of type optional with manufacturer, in accordance with NAAWS or WDMA I.S.1-A.
 - 2. Provide mineral core where required for fire rating.
- F. Edge Construction:
 - 1. General:
 - a. Securely glue edge-bands to core. Top and bottom bands may be secured in place with machine joint.
 - b. Doweling of vertical to horizontal edge-bands for oversize doors is permitted.
 - 2. Vertical: Full length hardwood.
 - a. Transparent Finish: NAAWS Type D, 3/4-inch thick minimum after trimming, Structural Composite Lumber (SCL) backer, with cross band edges covered.
 - 3. Horizontal: SCL, 1-1/4-inch thick minimum after trimming.

4. Edge bands shall match face veneer at transparent finish.

2.5 DOOR ACCESSORIES

- A. Vision Light Frames: 20-gage cold-rolled steel; Anemostat "LoPro," or equal.
 1. Finish: Manufacturer's standard pretreatment and primer; units shall be field finished painted as specified in Section 09 9000, "Painting and Coating," to match door finish.

2.6 FINISHING

- A. General: Finishing shall conform to NAAWS "Premium" Grade requirements with shop applied coatings applied in accordance with manufacturer's written instructions.
- B. Preparation Requirements:
 1. Seal the top and bottom edges of all doors and around all cutouts with two coats of varnish or sealer before the hardware is set into place.
 2. All four edges of doors, door faces, and factory-made cutouts shall be primed or sealed before factory-installed hardware is set into place.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that doorframes are of type required for door and are installed as required for proper installation of doors.
- B. Do not install doors in frames which would hinder door operation.
- C. Condition doors to average prevailing humidity in installation area prior to hanging.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and requirements of NAAWS or WDMA Standards.
- B. Door Bevel:
 1. Nonrated Doors: Bevel 1/8 inch in 2 inches.
- C. Hardware: For installation see Section 08 7100, "Door Hardware."
- D. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

3.3 ADJUST AND CLEAN

- A. Replace or rehang doors which are hinge bound and do not swing or operate freely.
- B. Protect installed wood doors from damage or deterioration until acceptance of work.
- C. Refinish or replace finished doors damaged during installation as directed by the Architect.

END OF SECTION

SECTION 08 3100

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors in walls and ceilings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment; coordinate installation with work of other trades.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Indicate locations of required access doors not shown on the Drawings.
- B. Product Data: Manufacturer's specifications and installation instructions.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in UL "Classified Building Materials Index" for the rating indicated. Provide UL label on each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Metal Access Doors for Walls and Ceilings: Milcor Inc. as specified and the basis of design, Karp Associates, Inc., Nystrom Building Products, J. L. Industries, or equal.

2.2 MATERIALS AND FABRICATION

- A. Gypsum Board Partitions and Ceilings – Nonrated: Model M.
 - 1. Style: Flanged type for flush mounting with concealed frames.
 - 2. Frame: 16 gage galvanized steel with 1 inch wall frame, 1-5/8 inches deep.
 - 3. Door: 16 gage steel.
 - 4. Hinges: Continuous piano type or concealed spring allowing opening to not less than 120 degrees.
 - 5. Finish: Gray powder coat, factory applied.
- B. Gypsum Board Tiled Partitions and Ceilings at Wet Areas- Nonrated: Model MS.
 - 1. Trim Style: 1 inch wide, flush flange.
 - 2. Frame: 16-gage Type 304 stainless steel.
 - 3. Door: 16 gage Type 304 stainless steel.
 - 4. Hinges: Continuous piano type, allowing opening to not less than 120 degrees.

- C. Latching Device:
 - 1. Typical: Spring loaded, screwdriver operated, sliding bolt or cam lock of number required to hold door in flush, smooth plane when closed.
 - 2. Key-operated cylinder lock.
 - a. Provide two keys per lock and key locks alike, unless otherwise scheduled or directed by the Architect.
 - b. For locks on panels 24 inches in any dimension, provide interior latch mechanism to allow door to be opened from the inside without a key.
 - c. Coordinate keying with Section 08 7100, "Door Hardware."
- D. Finishes:
 - 1. Typical: Factory-applied rust-resistant prime coat. Doors shall be field finish painted to match adjacent wall finish.
 - 2. Exterior Doors: Manufacturer's standard white powder coat.
 - 3. Stainless Steel: AISI No. 3 satin finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which access doors are to be installed. Do not proceed with work until unsatisfactory conditions are corrected; installation signifies acceptance of conditions.

3.2 INSTALLATION

- A. Comply with manufacturer's installation instructions for access doors.
- B. Install fire rated access doors in accordance with NFPA 80.
- C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces in accordance with manufacturer's instructions for installation.
- D. Install in locations required to give access to plumbing, mechanical, electrical, or similar devices concealed in walls or ceilings, whether or not specifically indicated on the Drawings.
- E. When installed in tile surfaces, coordinate panel location with the tilework so that the panel will align and fit within the tile module with no tile cutting, or a minimum of cutting.
- F. Conceal frames with tape and joint compound at painted gypsum board partitions as specified in Section 09 2900, "Gypsum Board."
- G. Adjust hardware and doors after installation for proper operation.
- H. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 3323

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Manually-operated overhead insulated coiling doors.
- B. Related Sections:
 - 1. Metal Fabrications: Section 05 5000; door opening jamb and head members.
 - 2. Door Hardware: Section 08 7100; masterkeyed cylinder.
 - 3. Painting and Coating: Section 09 9000; field painting.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000 "Contract Closeout" and Section 01 7800, "Project Records Documents".

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Fully detailed showing materials, gages, sizes, sections, construction, operation, anchoring methods, and relationship to adjacent materials.
- B. Product Data: Manufacturer's catalog cuts, specifications and other data as necessary to demonstrate compliance with these specifications. Include printed installation instructions and general recommendations for operation.

1.4 CLOSEOUT SUBMITTALS

- A. Manufacturer's maintenance and service data including address and telephone number of nearest authorized service representative.

1.5 QUALITY ASSURANCE

- A. Installation shall be by manufacturer, manufacturer's authorized representative, or other mechanics experienced and skilled with a minimum of five years' experience in installation of doors of the type specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during shipping, handling, and storage against damage. Dents and other defects are not acceptable.
- B. Comply with additional requirements specified in Section 01 6100, "Materials and Equipment."

1.7 FIELD CONDITIONS

- A. Coordinate with fabrication and installation of coiling door with work of other trades which interface with work specified in this Section.

- B. Verify measurements at site prior to fabrication to insure proper fit.

1.8 WARRANTY

- A. Manufacturer: Provide District with manufacturer' standard 2-year warranty against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Air Infiltration to Comply With:
 - 1. ASHRAE® (American Society of Heating, Refrigeration, and Air-Conditioning Engineers) Standard 90.1-2007, 2010 & 2013 requirements of less than .3 CFM/FT2
 - 2. IECC® (International Energy Conservation Code) 2012 requirements of less than 1.0 CFM/FT2
- B. Wind Loading:
 - 1. Supply doors to withstand up to 32.3 psf design wind load.
- C. Cycle Life:
 - 1. Design doors of standard construction for normal use of up to 20 cycles per day maximum, and an overall maximum of 50,000 operating cycles for the life of the door
- D. Seismic Performance:
 - 1. Provide manufacturer's seismic calculations confirming ASCE7-10
- E. Insulated Door Slat Material Requirements:
 - 1. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84
 - 2. Sound Transmission Class (STC) rating up to 30 for the curtain and up to 22 for the entire assembly.
 - 3. Minimum R-value of 8.0 (U-value of 0.125) as calculated using the ASHRAE Handbook of Fundamentals
 - 4. Insulation to be CFC Free with an Ozone Depletion Potential (ODP) rating of zero
- F. Safety
 - 1. Chain operated doors shall be designed so that the door immediately stops upward or downward travel and is maintained in a stationary position when the hand chain is released by user.

2.2 MANUFACTURER

- A. Acceptable Manufacturers:
 - 1. Cookson: 1901 South Litchfield, Goodyear, AZ 85338; Phone: (800) 294-4358;
 - 2. Cornell: 24 Elmwood Avenue, Mountain Top, PA 18707; Phone: (877) 640-8825
 - 3. Alpine: 8 Hulse Road, East Setauket, NY 11733; Phone: (631) 473-9300
 - 4. Or approved equal.

2.3 MATERIALS

- A. Thermiser Max Insulated Door Model ESD30 by Cookson, Inc. is specified as the basis of design.

- B. Curtain: Air infiltration rate of less than .3 CFM/FT², as tested per ASTM E283 validated by an independent testing agency. Test report required.
1. Slat Material: No. 6F, (Listed Exterior/Interior):
 - a. Galvanized Steel/Galvanized Steel: 22/24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.
 - b. Insulation: 7/8 inch (22 mm) foamed-in-place, closed cell urethane.
 - c. Total Slat Thickness: 15/16 inch (24 mm).
 - d. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84.
 - e. Slat has an R-value of 8.0
 - f. STC rating: Sound Transmission Class (STC) rating up to 30 for the curtain and up to 22 for the entire assembly
 2. Exterior Slat Finish:
 - a. GalvaNex™ Coating System and phosphate treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better.
 3. Interior Slat Finish:
 - a. GalvaNex™ Coating System and phosphate treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better.
- C. Endlocks: Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two ¼ inch (6.35 mm) rivets. Provide windlocks as required to meet specified wind load.
- D. Bottom Bar:
1. Configuration:
 - a. Insulated Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Min. 4" tall x 1-1/6" thickness.
 - b. Bottom Bar Finish:
 - 1) Exterior Face: Match slats.
 - 2) Interior Face: Powder coat to match slats.
 2. Air Infiltration Certification Label: Must be affixed to bottom bar
- E. Guides:
1. Fabrication:
 - a. Thermal break required. Minimum 3/16 inch (4.76 mm) structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
 2. Finish:
 - a. Manufacturer's standard pretreatment process and chemical bonded baked-on base coat and gray baked-on polyester enamel coat, Cookson "GalvaNex" or equal.
 - a) Gray powder coat shall receive manufacturer's zirconium treatment followed by a baked-on polyester powder coat with minimum 2.5 mils cured film thickness and complying with ASTM D 3363 pencil hardness: H or better' Cookson "SpectraShield" coating, or equal.
 - b) Color: As selected by Architect from manufacturer's full standard color range.
 - c) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

- F. Counterbalance Shaft Assembly:
 - 1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 - 2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.
- G. Brackets: Min. 3/16" (5mm) reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - 1. Finish: To match curtain.
- H. Hood: Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch steel intermediate support brackets.
 - 1. Finish: To match curtain.
- I. Weatherstripping:
 - 1. Bottom Bar: Replaceable, bulb-style, compressible EDPM gasket extending into guides.
 - 2. Guides: Replaceable vinyl strip on guides sealing against both sides of curtain.
 - 3. Lintel Seal: Double brush seal with EPDM sandwiched between the two brush seals at door header to impede air flow.

2.4 OPERATION:

- A. Manual ControlGard Chain Hoist: Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide. Chain hoist to include integral brake mechanism that will immediately stop upward or downward travel and maintain the door in a stationary position when the hand chain is released by the use.

2.5 ACCESSORIES

- A. Locking: Center mounted thumb turn cylinder interlocking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that openings are prepared with headers level, jambs plumb, counter level, and without projections and are correctly dimensioned to receive rolling doors.
- B. Begin installation of rolling doors only when conditions are satisfactory.

3.2 INSTALLATION

- A. Installation shall be in strict conformance with manufacturer's instructions and Contract requirements, as complete units ready for operation, and effectively closing opening as intended.
- B. Check moving parts for proper lubrication where required, and make adjustments for smooth, easy operation.
- C. Test, adjust, and lubricate roll-up door for proper operation. Adjustments and replacements of parts shall be made before final acceptance.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train District's maintenance personnel to adjust, operate, and maintain overhead coiling door.

END OF SECTION

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SECTION 08 4113

ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Aluminum framing system for exterior storefronts incorporating the following.
 - 1. Glazing.
 - 2. Glazing gaskets.
 - 3. Sills, trim, mullion extensions, and similar border and filler items.
 - 4. Anchors, shims, fasteners, inserts, accessories and support brackets.
 - 5. Supplemental internal reinforcing and secondary bracing.
- B. Related Requirements:
 - 1. Joint Sealants: Section 07 9200; system perimeter sealant and backup materials.
 - 2. Aluminum-Framed Entrances: Section 08 4213.
 - 3. Door Hardware: Section 08 7100; mortised hardware reinforcement requirements affecting storefront framing members.
 - 4. Glazing: Section 08 8000.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7800, "Project Records Documents".
- B. Pre-installation Meeting: Contractor shall schedule a meeting at the site to review storefront and entrance work after review and acceptance of shop drawing submittal.
 - 1. Notify participants at least 5 working days before conducting conference.
 - 2. Attendees: Architect and representatives of the Contractor, storefront and entrance installer, and other installers whose work may affect quality of installation.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show elevations, dimensions, member profiles, details of interface and attachment with adjacent building construction, entrances, and glazing materials.
 - 1. Show deviations from Contract Documents.
 - 2. Indicate field measurements.
- B. Product Data: Manufacturer's standard details for system components, performance data, finish, and installation instructions.
- C. Samples:
 - 1. Glass: As required by Section 08 8000, "Glazing."
 - 2. Finish: 12-inch-long section of typical stile extrusions in required width and with specified finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of fabricator/installer qualifications.
- B. Reports:
 - 1. Results of field water leakage tests by independent inspector.
 - 2. Record of pre-installation meeting.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: Company specializing in work of this Section, with not less than 10 years' experience on jobs of similar type and complexity, and approved by manufacturer.
- B. Manufacturer's Field Representative: A technical field representative of the manufacturer shall be at project site, as a minimum, at start, during middle, towards end of each storefront and entrance installation, and during field testing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated units and component parts to Project site, completely identified in accordance with numbering system used on shop drawings or erection diagrams.
- B. Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- C. Comply with additional requirements specified in Section 01 6000, "Material and Equipment."

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings.

1.9 WARRANTY

- A. Manufacturer: Furnish District with manufacturer's written 2-year warranty, cosigned by Contractor, agreeing to repair or replace work that fails in materials or workmanship. Failure includes:
 - 1. Glass breakage in excess of expected accidental breakage.
 - 2. Leakage or air infiltration in excess of specified requirements.
 - 3. Defects in hardware, weatherstripping, and other components of the work.

PART 2 - PRODUCTS

2.1 MANUFACTURED SYSTEM

- A. Exterior Storefront System: "Trifab 451UT" Framing (Thermal) by Kawneer as specified and the basis of design, USA Aluminum, Arcadia Inc., or equal.
 - 1. Mullions: 2 inch sightline by 4-1/2 inches deep.
 - 2. Glazing: Center, 4 side captured.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General:
 - 1. The storefront systems are a delegated design which requires a complete system designed and engineered to meet the requirements of the Contract Documents and to provide a complete weatherproof enclosure for the buildings.
 - 2. Contractor is responsible for coordination, compatibility, and design integrity to secure a weathertight seal of the storefront system and between system and interfacing surfaces and materials.
- B. Safety Glass Standard: Comply with CBC and CPSC 16 CFR 1201, and pass ANSI Z97.1.
- C. Performance Criteria for Exterior Storefronts:
 - 1. Strength: Design system to withstand wind loads acting normal to plane of wall as required by CBC, for the height and width of storefronts as shown on the Drawings.
 - a. Deflection: Maximum $L/175$ up to 13'-6" and $L/240 + 1/4$ " above 13'-6" with full recovery of glazing materials, when measured in accordance with ASTM E330.
 - b. Safety Factor: Unless otherwise specified, design parts and assemblies (including glazing stops, gaskets, adhesives, and sealants) for safety factor not less than 1.65.
 - 2. Air Leakage: Maximum 0.06 cfm/sf, ASTM E283, at differential static pressure of 6.24 psf at fixed glazing and not more than 0.3 cfm/sf at doors.
 - 3. Water Penetration/Leakage:
 - a. Static Pressure, ASTM E331: None, when subjected to water spray at 5 gallons per hour per square foot, at static pressure of 12 psf or 20 percent of design pressure for 15 minutes.
 - b. Dynamic Pressure, AAMA 501.1: None, when subjected to water spray at 5 gallons per hour per square foot and wind from a wind generator at static pressure of 12 psf or 20 percent of design pressure for 15 minutes.
 - 4. Energy Efficiency: Storefront system shall have certified energy performance ratings in accordance with NFRC standards and approved software.
 - a. Thermal Transmittance (U-factor): When tested to AAMA 1501, the U-factor shall not be more than 0.32 (low-e).
 - 5. Expansion/Contraction: System shall provide for expansion and contraction within system components caused by a temperature range of 180 degrees F over a 12-hour period without detrimental effect to system components.

2.3 METAL MATERIALS

- A. Extruded Aluminum: ASTM B221, 6063-T6 alloy and temper, size, and shape as required by design criteria but not less than 0.070" inch thick.
 - 1. Recycled Content: Shall have a minimum of 50% mixed pre- and post-consumer recycled content.
 - a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - c. Indicate location recovery of recycled content.
 - d. Indicate location of manufacturing facility.
- B. Sheet Aluminum: ASTM B209. Aluminum sheet for formed members shall be not less than 0.05 inch thick.
- C. Fasteners, Anchors, Embeds, and Miscellaneous Fastening Devices: Concealed type; aluminum, stainless steel, or other noncorrosive material compatible with aluminum.
- D. Steel: ASTM A36.

2.4 GLASS AND GLAZING MATERIALS

- A. Glass: Clear, insulating, as specified in Section 08 8000, "Glazing."
- B. Glazing Materials:
 - 1. General: Materials shall achieve weather, moisture, and air infiltration requirements and comply with requirements of Section 08 8000, "Glazing."
 - 2. Gaskets: Elastomeric, as recommended or provided by system manufacturer.

2.5 SEALANT MATERIALS

- A. General:
 - 1. Use materials and application procedures as recommended by manufacturer. Seal joinery, fastener penetrations, and welds as required for watertight installation. Sealant on exposed finished surfaces will not be permitted.
 - 2. Use only non-hardening, non-shrinking, and non-migrating materials.
 - 3. For nonworking metal-to-metal joints within framing members, use small-joint sealant conforming to 803.3 as described in AAMA 800.
- B. Perimeter Sealants: As specified in Section 07 9200, "Joint Sealants."

2.6 ACCESSORIES

- A. Coating for Separation of Dissimilar Metals: Cold-applied asphalt mastic, zinc chromate paint, or other nonconductive, non-absorptive material.
- B. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- C. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Flashings: Comply with requirements of Section 07 6200, "Sheet Metal Flashing and Trim."
 - 1. Exposed: Aluminum, finish to match storefront sections.
 - 2. Concealed: Dead-soft stainless steel, 26 gage minimum; extruded aluminum, 0.062 inch minimum; or an alloy and type selected by manufacturer for compatibility with other components.
- E. Slip-Joint Accessories: Pads, sheets, shims, or washers that allow free movement and prevent corrosion "freeze-up."
- F. Fasteners: Aluminum, nonmagnetic stainless steel or other non-corrosive material compatible with aluminum window members, trim hardware, anchors, and other components. Provide reinforcement where fasteners are screwed into aluminum members of less than 1/8-inch thickness.
- G. Anchoring Devices: Corrosion resistant type capable of supporting entrance system and superimposed design loads; design to allow adjustments of system prior to being permanently fastened in place.
- H. Miscellaneous Concealed Metal Members: Aluminum or nonmagnetic stainless steel. Members that are not exposed to weather or abrasion may ferrous steel coated as specified.

2.7 FABRICATION

A. General:

1. Verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings.
2. Maintain accurate relationships of planes and angles, with hairline fit of contacting members.
3. Internal supplemental steel reinforcing, if required, shall be indicated on submittals and shall be galvanized.

B. Framing:

1. Mullions: Extruded aluminum, designed for fully captured glazing.
2. Framing shall be accurately assembled, with no exposed fasteners, utilizing extruded splines, shear blocks, and/or snap-in features.
3. Exposed Flashings and Trim: Brake-formed aluminum, finish to match storefront wall mullion sections, secured with concealed fastening method.

2.8 PROTECTIVE COATINGS AND FINISHES

A. General:

1. Perform all finishing prior to shipping to Project site.
2. Protect against galvanic action where dissimilar metals are in contact, except in case of aluminum in contact with galvanized steel, zinc, or relatively small areas of stainless steel or nickel silver (white bronze). Protect by applying specified coating or by application of an appropriate sealant or tape.

B. Ferrous Metal:

1. Hot-dip galvanize in accordance with ASTM A123 after fabrication. Touch up damaged galvanized surfaces and welds with zinc-rich paint.
2. Contractor's Option: In lieu of hot-dip galvanize, use zinc-rich paint as following manufacturer's surface preparation and application requirements.

C. Exposed Aluminum: Architectural Class I dark bronze anodic coating conforming to AA-M10C22A44.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coat dissimilar metals in drainage cavities, using specified material. Aluminum, stainless steel, zinc, cadmium, and small areas of white bronze are not considered dissimilar from each other.
- B. Coat metals that come into contact with masonry, concrete and treated wood using specified material.
- C. Clean and touch up welds, bolted connections, and abraded areas of concealed galvanized steel in accordance with ASTM A780, using galvanizing-repair paint.

3.2 INSTALLATION

- A. Install aluminum framed storefront assemblies in accordance with manufacturer's recommendations and installation requirements for weathertight installation.

- B. Comply with manufacturer's instructions, drawings, specifications, and reviewed submittals.
- C. Ensure assemblies are plumb, level and free of warp or twist; and in alignment with adjacent work.
- D. Anchor securely to surrounding construction as detailed and required.
- E. Finished aluminum work shall be free of waves, buckles, dents, or other defects.
- F. Moldings joined at corners shall be accurately cut and neatly fitted to result in a tightly closed miter.
- G. Install glass in accordance with Section 08 8000, "Glazing," and manufacturer's instructions in order to achieve performance criteria.
 - 1. Ensure proper seating of gaskets for continuous contact with glass around perimeter of glazed openings.
 - 2. Do not allow glass to touch metal surfaces.
- H. Sealant:
 - 1. General:
 - a. Apply in accordance with sealant manufacturer's written instructions.
 - b. Install perimeter sealant to method required to achieve performance criteria.
 - 2. Clean and prime substrate surfaces in accordance with manufacturer's recommendations.
 - 3. Comply with additional requirements specified in Section 07 9200, "Joint Sealants."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's representative shall inspect material and installation to insure installation is proceeding in accordance with manufacturer's recommendations.
- B. Testing:
 - 1. General:
 - a. Testing shall be performed after installation and curing of sealants.
 - b. Tests shall be observed by a full-time independent inspector at Contractor's expense.
 - c. Correct deficiencies and modify system at no additional cost to District. Retest to assure no leakage.
 - d. Testing does not relieve guarantee responsibility required for watertightness.
 - 2. Required Test: Field "hose" test complying with AAMA 501.2 shall be performed on the installed storefront system to evaluate installed performance.

3.4 CLEANING AND TOUCH-UP

- A. Leave manufacturer's labels in place, intact, and legible until installation is reviewed and accepted. After initial inspection, remove labels, protective coating, and other foreign materials from glass and aluminum surfaces.
- B. Aluminum components with damage to finish, as determined as unacceptable by the Architect, shall be replaced at no additional cost to District.

END OF SECTION

SECTION 08 4213

ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum and glass swing entrances.
 - 2. Hardware for entrances.

- B. Related Requirements:
 - 1. Aluminum-Framed Storefronts: Section 08 4113.
 - 2. Door Hardware: Section 08 7100; hinges, exit and locking devices, closers, cylinders, thresholds, and other components.
 - 3. Glazing: Section 08 8000; requirements for system glass, glazing, glazing gaskets and sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7800, "Project Records Documents".

- B. Coordination: Coordinate installation of aluminum entrances with aluminum-framed storefront so as to produce a weatherproof and waterproof installation.

- C. Pre-installation Meeting: Attendance is required at pre-installation meeting specified in Section 08 4313, "Aluminum-Framed Storefronts."

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show elevations, dimension, member profiles, details of interface with storefront framing, reinforcement, and glazing materials and methods.
 - 1. Indicate deviations from the Contract Documents.
 - 2. Indicate field measurements.
 - 3. Manufacturer's standard drawings modified to show clearly that actual Project conditions and proposed work are acceptable.

- B. Product Data: Manufacturer's literature for each door configuration and for hardware items provided by door manufacturer. Include construction details, material descriptions, dimensions of individual components and profiles, and factory-applied finish.

- C. Samples: 12-inch-long section of typical stile extrusions in required width and finish.

- D. Hardware Schedule:
 - 1. Detailed hardware Groups/Sets for each opening.
 - 2. Schedule shall be prepared under direct supervision of a member of the Door and Hardware Institute (DHI).
 - 3. Coordinate function requirements with the Architect prior to submission of Schedule.

4. Coordinate with the Hardware Schedule required under in Section 08 7100, "Door Hardware."
5. Review of Hardware Schedule shall not be construed as certifying that the list is complete.

1.4 INFORMATIONAL SUBMITTALS

- A. Verification of compliance with specified performance criteria.
- B. Statement of fabricator/installer qualifications, if requested.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Contractor shall engage a single manufacturer to assume undivided responsibility for producing aluminum-framed entrances and storefront framing for this Project with a record of successful in-service performance.
- B. Fabricator/Installer Qualifications: Documented experience on jobs of similar type and complexity, and approved by manufacturer.
- C. Comply with AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated units and component parts to Project site completely identified in accordance with numbering system used on shop drawings or erection diagrams.
- B. Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 WARRANTY

- A. Manufacturer: Furnish District with the following manufacturer warranties.
 1. Entrances: 2-years, co-signed by Contractor and installer, agreeing to repair or replace work that fails in materials or workmanship.
 - a. Failure includes failure to perform as specified, and deterioration of finish or construction in excess of that to be expected under normal weathering and use.
 2. Insulating Glass: As specified in Section 08 8000, "Glazing."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design:
 1. Flushline™ Entrance door by Kawneer Company Inc.
 - a. Door: Flushline
 - b. Vertical Stile: 5"

- c. Top Rail: 5"
 - d. Bottom Rail: 5"
 2. The door face sheet shall be architectural quality aluminum sheet 0.090" thick plain unpatterned.
 3. Vision lites shall be aluminum-framed vision lite (AVL)
 - 1) Glass for vision lites to be 1" insulated clear tempered glass.
 - 2) Vision lite glazing shall be with foam glazing tape.
 - 3) Glazing stops: Square
- B. Other acceptable manufacturers:
1. US Aluminum Corp: www.usalum.com
 2. Arcadia Inc.: <https://arcadiainc.com>

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. General Design Requirements: Comply with recommendations of AAMA "Aluminum Store Front and Entrance Manual" except where more stringent requirements are specified or required by applicable codes.
- B. Performance Requirements:
1. Air Infiltration for Exterior Doors, ASTM E283:
 - a. Pairs of Doors: Maximum of 2.3 cfm per linear foot of perimeter crack at a pressure differential of 1.56 psf.
 - b. Single Doors: Maximum of 2.0 cfm per linear foot of perimeter crack at a pressure differential of 6.24 psf.
 2. Expansion/Contraction: System shall provide for expansion and contraction caused by a temperature range of 170 degrees F over a 12-hour period.
 3. Meet resistance to corner racking when tested by the Dual Moment Load test.

2.3 MATERIALS AND COMPONENTS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed flush door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.
1. Recycled Content: Shall have a minimum of 50% mixed pre- and post-consumer recycled content.
 - a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - c. Indicate location recovery of recycled content.
 - d. Indicate location of manufacturing facility.
- B. Aluminum-Framed Flush Entrance Door Core: Shall be urethane foam injected at 5 lb./cu.ft. density and shall have "0" O.D.P. = "Zero" Ozone Depletion Potential and contains no Chlorofluorocarbons (CFC's) or Hydro chlorofluorocarbons (HCFC's).
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed flush entrance door members, trim hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

- E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated..

2.4 STOREFRONT FRAMING SYSTEM

- A. Storefront Entrance Framing Thermal Trifab™ 451UT
 - 1. Thermally Broken Entrance Framing - Kawneer IsoLock™ Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density urethane, which is mechanically and adhesively joined to aluminum storefront sections.
 - a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- B. Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.5 GLAZING

- A. Glazing Gaskets: Full-Density EPDM conforming to NAAMM Standard SG-1.
- B. Glazing Blocks, Spacers, and Accessories: Comply with requirements specified in Section 08 8000, "Glazing."
- C. Glass: To match scheduled glazing of adjacent storefront framing.

2.6 HARDWARE

- A. General:
 - 1. Coordinate hardware and door application requirements of manufacturer with hardware supplied by Section 08 7100, "Door Hardware."
 - 2. Furnish and install all devices and components for each hardware Groups/Set in accordance with the Drawings and Specifications.
 - 3. Weatherstripping: As standard of door manufacturer or are required to meet specified performance criteria:
- B. Groups of Hardware for Doors at Locations Shown on the Drawings and Door Schedule, Keying, and Additional Hardware Requirements for Each Opening: As specified in Section 08 7100, "Door Hardware."

2.7 FABRICATION

- A. General:
 - 1. Whenever it is necessary to proceed with fabrication without actual field measurements, provide adequate fabrication and installation tolerances for proper fit.
 - 2. Maintain accurate relationships of planes and angles, with hairline fit of contacting members.

3. Perform fabrication operations, including cutting, fitting, forming, drilling, and grinding of metalwork in such a manner as to prevent damage to exposed prefinished surfaces.
- B. Corner construction shall consist of mechanical clip fastening and SIGMA deep-penetration plug welds at top and bottom of channel clip. Provide SIGMA fillet welds along both top and bottom webs of rail extrusion.
- C. Provide with internal reinforcement for both manufacturer's standard and specified door hardware.
- D. Extruded aluminum glazing stops shall be of square design, permanently anchored on exterior side and removable on interior side.
- E. Arrange fasteners and attachments to conceal from view. Exposed screws are not permitted.
- F. Weatherstripping shall be locked into extruded grooves in door frame as indicated on manufacturer's drawings and details.
- G. Maximum Allowable Door Gaps for Exterior Doors:
 1. Gaps between doors and headers and doors and jambs are to be a maximum of 1/8 inch.
 2. Gaps between double doors and doors and thresholds are to be a maximum of 1/4 inch with a gap over 1/4 inch to be covered by a surface applied brush seal.

2.8 FINISHES

- A. General:
 1. Perform all finishing prior to shipping to Project site.
 2. Protect against galvanic action where dissimilar metals are in contact, except in case of aluminum in contact with galvanized steel, zinc, or relatively small areas of stainless steel or nickel silver (white bronze). Protect by applying one coat of specified bituminous paint or zinc chromate primer or by application of an appropriate sealant or tape.
- B. Factory Finishing: Architectural Class I clear anodic coating conforming to AA-M10C21A41.
- C. Face Sheet: Kawneer Aluminum to match above.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions, drawings, specifications, and reviewed submittals. Erection shall be plumb, level, square, and in proper alignment and relationship to other work.
- B. Glazing shall comply with requirements of Section 08 8000, "Glazing." Ensure proper seating of gaskets for continuous contact with glass around perimeter of glazed openings.
- C. Adjust entrances for proper operation of each door and its mechanical hardware. Comply with additional hardware installation requirements specified in Section 08 7100, "Door Hardware." Coordinate with District's security consultant.
- D. Finished work shall be free of waves, buckles, dents, or other defects.

3.2 CLEANING, PROTECTION AND ADJUSTMENT

- A. Leave manufacturer's labels in place, intact, and legible until installation is reviewed and accepted. After initial inspection, remove labels, protective coating, and other foreign materials from glass and metal surfaces.
- B. Institute protective measures through remainder of construction period to ensure that aluminum-framed entrances will be without damage or deterioration at time of acceptance.
- C. Touch up field abrasions and damage to factory-painted finish.
 - 1. Touch-up shall be unnoticeable in completed installation.
 - 2. Entrances with damage to finish, as determined as unacceptable by the Architect, shall be replaced at no additional cost to District.

END OF SECTION

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SECTION 08 6223

TUBULAR SKYLIGHTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tubular daylighting devices and accessories.
- B. Related Sections
 - 1. Section 07 6200 – Sheet Metal Flashing and Trim.
 - 2. Section 07 6113 - Standing Seam Sheet Metal Roofing
 - 3. Section 09 5100 - Acoustic Tile Ceilings
 - 4. Division 26 Electrical

1.2 PERFORMANCE REQUIREMENTS

- A. SOLAMASTER 750 DS-O / 750 DS-C (OPEN/CLOSED CEILING)
 - 1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (530 mm) diameter, Type TDDOC and Type TDDCC.
 - a. Air Infiltration Test:
 - 1) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
 - b. Water Resistance Test:
 - 1) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psf (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E 547 and ASTM E 331.
 - c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
 - 1) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
 - 2. Fire Testing:
 - a. Fire Rated Roof Assemblies:
 - 1) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code for Class A, B, and C roof assemblies.
 - b. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the International Building Code.
 - c. Self-Ignition Temperature - Greater than 650 degrees F per ASTM D-1929.
 - d. Smoke Density: Rating no greater than 450 per ASTM E 84 in way intended for use. Classification C.
 - e. Rate of Burn and/or Extent: Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D 635.
 - f. Rate of Burn and/or Extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635.
 - 3. Fall Protection Performance:
 - a. Passes fall protection test: No penetration of dome or curb cap when subject to 400 lb (160 Kg)/42 inch (1066 mm) impact drop test when tested in accordance with OSHA 29 CFR 1926.506(c) Safety Net Systems.
 - b. Passes fall protection test: California State OSHA Fall Protection Code of

- Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.
4. Blast Resistance: ASTM F1642, ASTM F2912, GSA-TS01-2003, and UFC 4-010-01:
 - a. Airblast Loading ASTM Hazard Rating: Passes: No Hazard Rating
 - b. Airblast Loading UFC Level of Protection: Passes Medium Level of Protection
 - c. Dynamic Overpressure Loading ASTM Hazard Rating: Passes: No Hazard Rating
 - d. Dynamic Overpressure Loading UFC Level of Protection: Passes Medium Level of Protection

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 3300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
 4. Installation requirements.
- C. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.
- D. Electrical wiring diagrams and recommendations for power and control wiring.
- E. Verification Samples: As requested by Architect.
- F. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- G. Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features:
 1. LED Luminaires: Include estimated useful life, calculated based on IES LM-80 test data.
 2. In order to meet LM-80 lifetime projections, LM-80 Max Drive Current must not be exceeded. Lumen maintenance and lifetime predictions are valid for drive current and case temperature conditions used for LM-80 testing as included in the applicable LM-80 test report for these products.
- H. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
 1. List of Daylight Credits available for the products specified.
 2. Data on Energy Optimization Performance Credits for the products specified.
 3. Data on Perimeter and Non-Perimeter Controllability of Systems for use of Daylight Dimmer option with the products specified.
 4. Data on potential Innovation in Design Credits which may be available for the innovative use of the products specified.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty years experience in the top lighting industry. Secondary products shall be acceptable to the primary manufacturer.
- B. Installer Qualifications: All products shall be installed by a single installer with a minimum of

five years demonstrated experience, with adequate equipment, skilled workers, and practical experience to meet the project schedule.

- C. Skylights shall conform with authorities having jurisdiction and be designed to meet design criteria of the project location and the following:
1. Skylights must be certified by NFRC.
 2. Skylights must be Tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
 3. Skylights must have Factory Mutual (FM) Approval Class Number 4431.
 4. On projects which fall under the jurisdiction of the Florida Building Code, Skylights are required to have a current Florida Building Code (FBC) Number to meet the High Velocity Hurricane Zone (HVHZ) requirements and are required for acceptance of Work specified in this section. Skylight must comply with the jurisdictional code body's submittal data and supporting drawings and documentation. Where the code body's acceptance criteria differs from these specifications regarding components and hardware, the code body's requirements shall govern.
 5. Meet or exceed OSHA 200 pound (90 kg) Drop Tests expressed in 29 CFR 1910.23(e)(8)
 6. Skylights shall provide minimum 69 psf (3.30 kPa) design load.
- D. Pre-Installation Meeting: Contractor shall convene a pre-installation meeting on the project site minimum one week before beginning work of this Section. The meeting shall include the Architect or Owner's Representative and representatives of all related trades to:
1. Coordinate between the at least the following trades.
 - a. Roofing to install the flashing, skylight, and LED Light Kit (when specified)
 - b. Electrical to wire components and program lighting controls.
 2. Verify project requirements and site logistics.
 3. Assess integrity of the roofing system and building structure.
 4. Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

- A. Coordinate delivery schedule with the Contractor and project schedule to minimize on site storage.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Store materials in a dry area, protected from freezing, staining, contamination or damage.

1.7 WARRANTY

- A. Daylighting Device: Manufacturer's standard warranty for 10 years.
- B. Electrical Parts: Manufacturer's standard warranty for 5 years, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Solatube International, Inc., which is located at: Solatube International 2210 Oak Ridge Way; Vista, CA 92081-8341; Toll Free Tel: 888-765-2882; Tel: (415) 847-1802; Email:[request info \(hholko@solatube.com\)](mailto:request_info@solatube.com); Web:<http://www.solatube.com>
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 6200 "Product Options and Substitutions".

2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.
- B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
 - 1. Model:
 - a. Solatube Model 750 DS-C Closed (Penetrating) Ceiling. AAMA Type TDDCC.
 - 2. Capture Zone:
 - a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1) Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
 - a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
 - b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
 - c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
 - 3. Flashings:
 - a. Roof Flashing Base:
 - 1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A 792/A 792M, 0.028 inch (0.7 mm) plus or minus .006 inch (.015 mm) thick.
 - a) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches (685 mm by 685 mm) to cover curb as specified in Section 07600.
 - b. Curbs: Metal Insulated Roof Curb: Corrosion resistant 18 Gauge hot-dipped galvanized steel conforming to ASTM A 653 G90 with continuous welded seams, integrated base plate for water tightness and extra strength, lined with 1-1/2 inch fiberglass fireproof sound attenuating thermal insulation, factory installed 2 by 2 treated wood nailer secured to top ledge of curb. Curb designed for single-ply roofing, lightweight fill or tapered insulation low slope roof types.
 - 1) CXX Metal insulated curb with a custom curb height as determined by the installer.
 - c. Flashing Options:
 - 1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6

(OFxft2xhr/Btu) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, & HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2(OFxft2xhr/Btu). For use with Flashing Type FC.

4. Transfer Zone:
 - a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
 - 1) Reflective Tubes:
 - a) Reflective extension tube, Type EXX and Type EL with total length of run as indicated on the Drawings.
 - b) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
 - 2) Tube Options
 - a) Top Tube Angle Adapter and Bottom Tube Angle Adapter Kit: Type AK, Reflective 45 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long
 - b) Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.
5. Delivery Zone:
 - a. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
 - 1) Polymeric Transition Box: Type TP, round-to-square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch (2.8 mm) thick.
 - 2) Lens: Type L1, OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame and EPDM foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick. Classified as CC2.
 - b. Delivery Zone Options:
 - 1) Daylight Dimmer - 0 to 10 V Dimmer Control: Provide an electrical actuator controller, auxiliary switch(s), and cable as specified in Section 13800; Common Work Results Electrical Section 16000; and Lighting Equipment and Controls Section 16500.
 - a) Low Voltage Daylight Dimmer: Type D1, is an Electro-mechanically actuated daylight valve; 0-10 V Control, Class-2, UL Listed. Low voltage Daylight Dimmer electrical actuator provides for programmable (0 to 10VDC) scene-based dimming control for daylight output between 2 and 100 percent, auxiliary 12VDC dimming control for daylight output between 2 and 100 percent, or auxiliary ON/OFF control. Input voltage: 24VAC at 50 or 60 Hz.
 - 1) Programmable (0 to 10VDC) Control: requires an electrical actuator controller or building automation controller capable of producing a signal between 0 and +10 VDC (Min 50mA) to incrementally modulate up to 50 daisy chained Daylight Dimmers (Current Sinking) between fully closed at 0 to 1 volts to fully open at 9 to 10 volts.
 - 2) Auxiliary 12VDC Dimming Control: requires 12VDC Dimming Switch (Current Sourcing; 12VDC power supply not required).
 - a) Requires CL-2 (Min), 18AWG, stranded copper, two

- conductor, twisted cable from lighting controller to first dimmer and interconnecting between subsequent dimmers
- 3) Auxiliary ON/OFF Control: requires commercial or residential single pole electric light switch.
 - a) ON/OFF control requires CL-2 (Min), 22 AWG, stranded, three conductor, twisted cable from switch to first dimmer and CL-2 (Min), 18 AWG, stranded copper, two conductor twisted cable; interconnecting subsequent dimmers.
 - b) Power can be transformed from line voltage through use of a UL Listed Class-2, 24VAC Transformer.
6. Accessories
- a. Optional Low-voltage Transformer: Solatube Remote Transformer, Type TR20, is a 20VA, 24VAC, 50/60HZ, UL Listed, UL Category XOKV7, CE Marked, Class-2 Transformer with cover plate mounting system configured for easy field assembly onto standard 4.06 inch by 4.06 inch (103 mm by 103 mm) square junction box: Inherently Limited, Primary: 120VAC, 208VAC, 240VAC, and 277VAC. For use with Daylight Dimmer Type D1 only.
 - b. Optional Switch: Type S1, is a Low-voltage 0-10V Class 2 control switch (white) required to operate 0-10V Daylight Dimmer. Note: only one switch is required per set of up to 50 synchronously controlled dimmers. For use with 0-10V Daylight Dimmer, Type D1, only.
7. Catalog Number: S750DS-C-DA-FC-CCI-AK-EXX-E-TP-L1-D1-TR20-S1-CXX

2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.
- C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Coordinate requirements for power supply, conduit and wiring.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly and that finished installation is weather tight.
 - 1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
 - 2. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
 - 3. Coordinate attachment and seal of perimeter air and vapor barrier material.
- C. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer
- D. Align device free of warp or twist, maintain dimensional tolerances.
- E. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.
- F. Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance. Correct deficiencies.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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Model: Solatube 750 DS-C Closed Ceiling (21 in./530 mm Daylighting System)

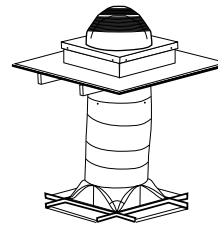
Project: _____ Location: _____ Type: _____

Product Specifications Appear in CSI Division 08, Section 08 62 23. For budgeting and quotations use only. Qty: _____

Model		Capture Zone				Transfer Zone			Delivery Zone												
<u>S</u>	<u>7</u>	<u>5</u>	<u>0</u>	<u>D</u>	<u>S</u>	-	<u>C</u>	-			-	<u>A</u>	<u>K</u>			-					
1		2	2a	3	3a	4	4a	4b	5	5a	5b	6									

1 Model

750 DS-C SolaMaster® Solatube 750 DS-C (21 in./530 mm Daylighting System)
Closed Ceiling



Capture Zone

2 Dome

- DA** Acrylic Dome
- DAI** Acrylic Outer Dome + Acrylic Inner Dome
- DPI** Acrylic Outer Dome + Polycarbonate Inner Dome (Required for High Velocity Hurricane Zones)
- MIL** Acrylic Dual Dome (Required for UFC-ATFP)

2a Dome Options (Leave blank if not desired)

- B** Security Bar **PB** Dome Edge Protection Band*
- SK** Dome Security Kit**

*Not for use with Curb Cap Flashing
**Inner dome required for Dome Security Kit

3 Flashings

- | | | |
|---|--|---|
| F4 4-inch Self Mounted  | F8 8-inch Self Mounted  | F11 11-inch Self Mounted  |
| FC Curb Cap (Curb by Others)  | FSM Metal Roof Flashing  | |

3a Flashing Options (Leave blank if not desired)

- | | |
|--|--------------------------------|
| T12*† Roof Flashing Turret Extension 12 in./300 mm | FI Flashing Insulator |
| T24*† Roof Flashing Turret Extension 24 in./600 mm | CI Curb Insulator |
| T36*† Roof Flashing Turret Extension 36 in./900 mm | CCI Curb Cap Insulation |
| T48*† Roof Flashing Turret Extension 48 in./1200 mm | |

* Specify additional extension tubes in #4a
† Comes with Bracket Kit

Transfer Zone

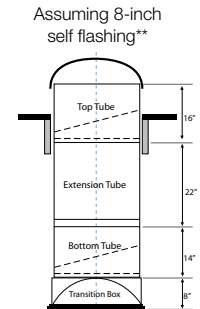
4 Top Tube and Bottom Tube Required

AK 16" Top Tube Angle Adapter and 16" Bottom Tube Angle Adapter

4a Extension Tubes Required

Run measured from top of roof deck to bottom of ceiling plane along centerline of tubing (allow for 2" overlap) using 24" lengths. See 4b for optional 48" length.

- | | |
|---|---|
| E0 No Extension Tube – Max Run = 38" | E6* Six Extension Tubes – Max Run = 170" |
| E1* One Extension Tube – Max Run = 60" | E7* Seven Extension Tubes – Max Run = 192" |
| E2* Two Extension Tubes – Max Run = 82" | E8* Eight Extension Tubes – Max Run = 214" |
| E3* Three Extension Tubes – Max Run = 104" | E9* Nine Extension Tubes – Max Run = 236" |
| E4* Four Extension Tubes – Max Run = 126" | E10* Ten Extension Tubes – Max Run = 258" |
| E5* Five Extension Tubes – Max Run = 148" | EXX* Total Run Length to be Determined by Bidding Contractor |



*Compatible with dome ring to be used as a top tube or extension tube
**Total tube run will vary depending on flashing used.

4b Extension Tube Options (Leave blank if not desired)

- | | |
|---|--|
| A1 One 0-90 Degree Extension Tube (Angle Adapter) | E Wire Suspension Kit (50 ft.) |
| A2 Two 0-90 Degree Extension Tubes (Angle Adapter) | EL Optional 48" Extension Tube (Substitute one 48" for two 24" above) |

Delivery Zone

5 Diffuser Lens

- L1** OptiView® Diffuser  **L2** Prismatic Diffuser 

Diffuser/Ceiling Assembly includes transition box.

5a Effect Lens* (Leave blank if not desired)

- LN** Natural Effect Lens

*Effect Lens is optional; does not come standard.

5b Options (Leave blank if not desired)

- D** Daylight Dimmer™

6 Measurement Standard

- M** Metric **I** Imperial

Accessories (Order separately)

- SW** Low voltage switch (white) required to operate Solatube Daylight Dimmers. Note: Only one switch is required per ten (10) synchronously controlled dimmers.
- CA** Two Conductor Low Voltage Cable (500 ft.)

Example

750 DS-C-DAI-FSM-AK-E3-L1-LN-I

SolaMaster Series® 750 DS-C (21 in./530 mm Daylighting System), Acrylic Outer Dome + Acrylic Inner Dome, Metal Roof Flashing, 16" Top Tube Angle Adapter and 16" Bottom Tube Angle Adapter, Three Extension Tubes, OptiView® Diffuser, Transition Box and Natural Effect Lens. For non-metric installations.

SECTION 08 7100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
 - 1. Door Hardware, including electric hardware.
 - 2. Storefront and Entrance door hardware.
 - 3. Gate Hardware.
 - 4. Digital keypad access control devices.
 - 5. Hold-open closers with smoke detectors.
 - 6. Wall or floor-mounted electromagnetic hold-open devices.
 - 7. Power supplies for electric hardware.
 - 8. Low-energy door operators plus sensors and actuators.
 - 9. Thresholds, gasketing and weather-stripping.
 - 10. Door silencers or mutes.
- C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
 - 1. Division 8: Section - Steel Doors and Frames.
 - 2. Division 8: Section - Wood Doors.
 - 3. Division 8: Section - Aluminum Storefront
 - 4. Division 28: Section - Fire/Life-Safety Systems & Security Access Systems.

1.3 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

- A. 2019 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies

- F. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

1.4 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit six (6) copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
 - 1. Include a Cover Sheet with;
 - a. Job Name, location, telephone number.
 - b. Architects name, location and telephone number.
 - c. Contractors name, location, telephone number and job number.
 - d. Suppliers name, location, telephone number and job number.
 - e. Hardware consultant's name, location and telephone number.
 - 2. Job Index information included;
 - a. Numerical door number index including; door number, hardware heading number and page number.
 - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
 - c. Manufacturers' names and abbreviations for all materials.
 - d. Explanation of abbreviations, symbols, and codes used in the schedule.
 - e. Mounting locations for hardware.
 - f. Clarification statements or questions.
 - g. Catalog cuts and manufacturer's technical data and instructions.
 - 3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keypad Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.5 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
 - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.

- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.7 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Locksets: "L" Series (3) years – "ND" Ten (10) years.
 - 2. Electronic: One (1) year.
 - 3. Closers: Thirty (30) years –1260 twenty (20) years –Concealed High Security fifteen (15) years --except electronic closers shall be two (2) years.
 - 4. Exit devices: Three (3) years.
 - 5. All other hardware: Two (2) years.

1.8 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.

- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner’s keying standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	District Standard
Locks, Latches & Cylinders	Schlage	District Standard
Exit Devices	Von Duprin	District Standard
Closers	LCN	District Standard
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Dust Proof Strikes	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Thresholds	Zero	Pemko, National Guard
Seals & Bottoms	Zero	Pemko, National Guard

2.2 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
 - 1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42" wide: 4-1/2" inches.
 - 2) Doors 43" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 - 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

- B. Floor Closers: Shall be equipped with compression springs, cam and roller operating mechanism and a one piece spindle-cam for maximum operating performance and longevity.
- C. Pivots: High strength forgings and castings with precision bearings for smooth operation. Positive locking vertical adjustment mechanism to allow installer to precisely position the door and balance the load.
- D. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.
- E. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.
 - 1. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
 - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
 - b. Offset lever pull – minimum 1,600 foot pounds without gaining access
 - c. Vertical lever impact – minimum 100 impacts without gaining access
 - 2. Cycle life - tested to minimum 16 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers
 - 3. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
 - 4. Cylinders: Refer to "KEYING" article, herein.
 - 5. Provide solid steel anti-rotation through bolts and posts to control excessive rotation of lever.
 - 6. Provide lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
 - 7. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw capable of UL listing of 3 hours on a 4' x 10' opening. Provide proper latch throw for UL listing at pairs.
 - 8. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 9. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 10. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 11. Provide wired electrified options as scheduled in the hardware sets.
 - a. 12 through 24 volt DC operating capability, auto-detecting
 - b. Selectable EL (fail safe)/EU (fail secure) operating mode via switch on chassis
 - c. 0.230A (230mA) maximum current draw
 - d. 0.010A (10mA) holding current
 - e. Modular / "plug in" request to exit switch
 - 12. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
- F. Schlage "L" Series as scheduled with "06" Style Lever and "A" Style Rose.
 - 1. Locksets to comply with ANSI A156.13, Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims. Locksets shall also comply with UL10C Positive Pressure requirements
 - 2. Lock case shall be manufactured with heavy 12 gauge steel with fully wrapped design. Lock cases with exposed edges are not acceptable. Lock case shall be multi-functional allowing transformation to a different function without opening lock case.
 - 3. Latchbolt shall have 3/4" throw and be non-handed, field reversible without opening the lock case. Solid latchbolts and / or plastic anti-friction devices are not acceptable.
 - 4. The deadbolt, when used, shall be 1" throw stainless steel with a 3/4" internal engagement when fully extended.

5. All trim shall be through-bolted with the spring cages supporting the trim attached to the lock cases to prevent torqueing.
 6. Levers to have independent rotation in both directions. Exterior lever assembly to be one-piece design attached by threaded bushing. Interior lever assembly shall be attached by screwless shank
 7. Thru-bolt lever assemblies through the door for positive interlock. Locks using a through the door spindle for attachment are not acceptable. Spindles shall be independent, designed to "break-away" at a maximum of 75psi torque.
 8. Hand of lock chassis to be changeable by simply moving one screw from one side to the case to the other and pulling and reversing the latchbolt.
 9. Cylinders to be secured by a cast stainless steel, dual retainer. Locks utilizing screws and / or stamped retainers are not acceptable.
- G. Deadlocks: Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of ¼" diameter steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike alloy deadbolt with reinforcer and two 3" long screws. ANSI A156.5, 2001 Grade 1 certified.
- H. Exit devices: Von Duprin as scheduled.
1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 3. Mechanism case shall have an average thickness of .140".
 4. Compression spring engineering.
 5. Non-handed basic device design with center case interchangeable with all functions.
 6. All devices shall have quiet return fluid dampeners.
 7. All latchbolts shall be deadlocking with ¾" throw and have a self-lubricating coating to reduce friction and wear.
 8. Device shall bear UL label for fire and or panic as may be required.
 9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
 10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
 11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
 12. Furnish glass bead kits for vision lites where required.
 13. All Exit Devices to be sex-bolted to the doors.
 14. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
 - a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.
 15. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09). Such conditions must be clearly demonstrated and indicated in the specification:
 - a. Such hardware has a 'dogging' feature.
 - b. It is dogged during the time the facility is open.
 - c. Such 'dogging' operation is performed only by employees as their job function (non-public use).
- I. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout

- the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
 3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
 4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
 5. Closers shall be installed to permit doors to swing 180 degrees.
 6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
 7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
 8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.
- J. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.
1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
 2. Provide dust proof strikes at openings using bottom bolts.
- K. Door Stops:
1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
 2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
 3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- L. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- M. Thresholds: As Scheduled and per details.

1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
 3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
 4. Thresholds shall comply with CBC Section 11B-404.2.5.
- N. Seals: Provide silicone gasket at all rated and exterior doors.
1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
 2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
 3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- O. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.
- P. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.3 KEYING INSTRUCTIONS PER THE DISTRICT

- A. Owner will provide the Facilities Team (PM/CM) Construction Cores and keys required for the project. PM/CM will provide to Maintenance & Operations the number of construction cores required and number of keys requested by the contractor.
- B. Owner will purchase all permanent cores & keys required for new buildings.
- C. PM/CM will provide the required list of cores needed for the project to the Maintenance & Operations maintenance supervisor for ordering.
- D. Owner will provide the Buildings Permanent Cores to the Facilities Team (PM/CM) for turn over to the Contractors Superintendent for installation.
- E. Contractor will return to the Facilities Team (PM/CM) all construction cores at one time. PM/CM will verify all construction cores are accounted for and number of keys issued are returned prior to returning to Maintenance & Operations.
- F. Owner will cut and issue all required building permanent keys.

2.4 FINISHES

- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.

- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.5 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
- I. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
- J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
- K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
- L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.3 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.4 HARDWARE LOCATIONS

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.5 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.6 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.
- C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

GLY	=	Glynn-Johnson Corporation	Overhead Door Stops
IVE	=	Ives	Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Push Pull & Kick Plates, Door Stops & Silencers
LCN	=	LCN	Door Closers
SCE	=	Schlage Electronics	Electronic Door Components
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
VON	=	Von Duprin	Exit Devices
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

HARDWARE GROUP NO. 01 - EXTERIOR / ACCESS CONTROL
A101

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	ELECTRIC STRIKE	6211AL FSE EB 12/16/24/28 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		VON
1	EA	CARD READER	CARD READER - WORK OF DIVISION 28		

HARDWARE GROUP NO. 02 - INTERIOR / LACTATION ROOM
A101A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE W/SIM RETRACT	L9056J 06A L583-363 L283-722	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 03 - EXTERIOR / PANIC HARDWARE / ACCESS CONTROL
A102

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-PA-AX-99-L-E996-06-FSE- CON 24 VDC	626	VON
1	EA	RIM HOUSING	20-079 (LESS CORE)	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		
1	EA	WIRE HARNESS	CON-XX (LENGTH AS REQUIRED)		SCH
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		VON
1	EA	CARD READER	CARD READER - WORK OF DIVISION 28		

HARDWARE GROUP NO. 04 - EXTERIOR / ROLL-UP DOOR
A102A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY DOOR MANUFACTURER		

HARDWARE GROUP NO. 05 - INTERIOR / CLASSROOM
A102B

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95JD RHO XN12-035	626	SCH
2	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HARDWARE GROUP NO. 06 - EXTERIOR PAIR / PANIC HARDWARE
A103

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-99-L-06	626	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-99-L-DT-06	626	VON
1	EA	RIM HOUSING	20-079 (LESS CORE)	626	SCH
1	EA	MORTISE CYLINDER	26-094 (LESS CORE)	626	SCH
2	EA	MORTISE CYLINDER	26-094 XQ11-948 (LESS CORE)	626	SCH
4	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

HARDWARE GROUP NO. 07 - INTERIOR / CUSTODIAL
A103A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	OH STOP	100S	630	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 08 - EXTERIOR / UNISEX RESTROOM

A104

A105

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	OFFICE W/SIM RETRACT	L9056T 06A L583-363 L283-722	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	LOCK GUARD	LG12	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

HARDWARE GROUP NO. 09 - EXTERIOR PAIR / MECH

A106

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

HARDWARE GROUP NO. 10 - EXTERIOR / ELECTRICAL / PANIC HARDWARE
A107

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	PA-AX-99-L-06	626	VON
1	EA	RIM HOUSING	20-079 (LESS CORE)	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

HARDWARE GROUP NO. 11 - INTERIOR / IDF / ACCESS CONTROL
A107A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	630	VON
1	EA	FLOOR STOP	FS436	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		VON
	EA	CARD READER	CARD READER - WORK OF DIVISION 28		

HARDWARE GROUP NO. 12 - EXTERIOR PAIR / GREENHOUSE
B101

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		

HARDWARE GROUP NO. 13 - EXTERIOR / SLIDING
B101A

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1		HARDWARE BY DOOR MANUFACTURER		

HARDWARE GROUP NO. 14 - EXTERIOR PAIR / STORAGE
D101

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA MANUAL FLUSH BOLT	FB458	626	IVE
1	EA DUST PROOF STRIKE	DP1	626	IVE
1	EA VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
2	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA FLOOR STOP/HOLDER	FS43	626	IVE
1	EA GASKETING	188SBK PSA	BK	ZER
2	EA DOOR SWEEP	39A	A	ZER
1	EA ASTRAGAL	43SP	SP	ZER
1	EA THRESHOLD	PER DETAIL		

HARDWARE GROUP NO. 15 - SGL GATE / PASSAGE
G1

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA PASSAGE SET	ND10S RHO	613	SCH
1		BALANCE OF HARDWARE BY GATE MANUFACTURER		

HARDWARE GROUP NO. 16 - PAIR GATES
G2 G3

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1		BALANCE OF HARDWARE BY GATE MANUFACTURER		

HARDWARE GROUP NO. 17 - SGL GATE
G4

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	VANDL STOREROOM LOCK	ND96JD RHO	626	SCH
1	EA	PERMANENT CORE	PERMANENT CORE PROVIDED BY OWNER	626	SCH
1			BALANCE OF HARDWARE BY GATE MANUFACTURER		

HARDWARE GROUP NO. 18 - SLIDING GATE
G5

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY GATE MANUFACTURER		

HARDWARE GROUP NO. 19 - SGL GATE
G6

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY GATE MANUFACTURER		

HARDWARE GROUP NO. 20 - VEHICLE GATES
G7

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY GATE MANUFACTURER		

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SECTION 08 8000

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements for factory and field-glazing of doors and windows.
 - 2. Unframed mirrors.
- B. Related Requirements:
 - 1. Hollow Metal Doors and Frames: Section 08 1113.
 - 2. Flush Wood Doors: Section 08 1416.
 - 3. Aluminum-Framed Entrances: Section 08 4213.
 - 4. Aluminum-Framed Storefronts: Section 08 4113.
 - 5. Toilet Accessories: Section 10 2813; pre-fabricated framed mirrors.
 - 6. Roller Shades: Section 12 2413.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Contract Closeout," and Section 01 7800, "Project Record Documents."
- B. Coordinate with work of other Sections for weathertight installation at interface with other materials and systems.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: As specified in related Sections for systems in which glazing is installed.
- B. Product Data: Manufacturer's literature substantiating that glass and glazing materials comply with specified requirements.
- C. Samples:
 - 1. Sample, 12 inches square, of each glass Type specified, except clear single-pane units.
 - 2. Affix to each sample the manufacturer's label describing glass assembly and performance properties.
 - 3. Samples may be submitted as part of sample submittals required under other Sections.

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of fabricator/installer qualifications for exterior field glazing.
- B. Certification that insulating glass units meet IGMA Class CBA requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty for insulating glass.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Fabricator: When the glass manufacturer has a certification program, the fabricator shall have a current "Certified Fabricator" certificate from the glass manufacturer.
 - 2. Glass Installer: Experience completing glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver glass with manufacturer's label indicating type, quality, and thickness on each piece.
- B. Protect glass and glazing materials during delivery, storage, and handling so as to comply with manufacturer's directions and as required to prevent face and edge damage to glass and damage to glass and glazing materials from effects of moisture, including condensation and other causes.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 WARRANTY

- A. Manufacturers: Furnish Owner with a written warranty for sealed insulating glass units in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within 10 years.
 - 1. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions
 - 2. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- B. In addition, warranty requirements of related Sections for systems in which glazing is installed shall apply to work of this Section.

PART 2 – PRODUCTS

2.1 PRIMARY GLASS MANUFACTURERS

- A. AGC Flat Glass North America Ltd.
- B. LOF Inc.
- C. Guardian Glass.
- D. Vitro Architectural Glass (formerly PPG Glass is basis of design)
- E. American St Gobain.
- F. Or equal.

2.2 FABRICATORS

- A. Viracon.
- B. Craftsman Fabricated Glass.
- C. JE Berkowitz.
- D. Arch Aluminum & Glass.

2.3 CRITERIA AND PERFORMANCE REQUIREMENTS

- A. Glass Thickness:
 - 1. Except as specified, glass thickness shall be as indicated on the Drawings or, where no thickness is given, shall be determined by Contractor for the wind loads and conditions of use at the Project site.
 - 2. In no case shall thickness be less than that required by the CBC.
- B. Provide watertight and airtight installation of each piece of exterior glass and sealed glass unit.
- C. Each installation shall withstand local normal thermal movement, temperature changes, wind loading, and impact loading (for operating sash and doors) without failure of any kind, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, loss of hermetic seal, deterioration of glazing materials, and other defects.
 - 1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 degrees F and from a consequent temperature range within glass and glass framing members of 180 degrees F.
- D. Regulatory Requirements:
 - 1. Comply with minimum glazing requirements of CBC Table 2403.2.1 including footnotes.
 - 2. Where safety glass is indicated or required, provide type of products indicated that comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category I or II materials, as applicable.
 - 3. Mirrors shall meet CPSC or ANSI safety glazing requirements and shall be certified by the Safety Glazing Certification Council (SGCC).
- E. Industry Standards:
 - 1. Insulating glass shall be certified under a certification program approved by the Insulating Glass Manufacturers Alliance (IGMA).
 - 2. Comply with GANA "Glazing Manual," except where more stringent requirements are indicated.
 - 3. Comply with applicable provisions of the AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."
- F. Minimum Wind Load for Exterior Glass and Glazing Assemblies: In accordance with CBC Chapter 16.

2.4 GLASS MATERIALS

- A. Annealed Float Glass: ASTM C1036, Type I, Class 1, Quality q3 or better.
- B. Heat-Strengthened and Tempered Float Glass: ASTM C1036, Type I float glass as specified above and conforming to requirements of ASTM C1048 and as specified.
 - 1. Tempered glass shall meet ANSI Z97.1 test requirements.
 - 2. Glass shall be tempered using the roller hearth method.
 - 3. Heat-strengthened glass shall have surface compression levels between 3500 and 7000 psi.
- C. Clear Mirror Glass: ASTM C1503, Select quality, 6.0 mm thick.
 - 1. Provide silver coating, copper-protective coating, and 1-mil-thick mirror backing paint.
 - 2. Comply with CS 27.

2.5 GLASS TYPES

- A. Vision Panels at Doors and Interior Windows: Clear, tempered float, 1/4 inch (6mm) thick, unless otherwise indicated or required for size of light.
- B. Storefront Glazing: Insulating.
 - 1. Exterior Light: Tinted float, heat strengthened; "Solargray" by Vitro Architectural Glass, or equal.
 - 2. Gap: 1/2 inch, air filled.
 - 3. Spacer Frame: Warm edge type in mill finish aluminum.
 - 4. Interior Light: Clear float, heat strengthened, with low E coating on the #3 surface; "Solarban 60" by Vitro Architectural Glass, or equal.
 - 5. Overall Unit Thickness: 1 inch.
 - 6. Provide tempered glass for both glass plies.

2.6 GLAZING MATERIALS

- A. Sealants:
 - 1. Interior Locations: One-part, gun grade acrylic; Tremco "Mono," Pecora "60 Plus" or equal.
 - 2. Exterior Locations: One-part, gun-grade silicone; GE "Silicone Construction Sealant Series SCS-1200," Dow-Corning "999 Building Sealant," or equal.
- B. Glazing Blocks and Spacers:
 - 1. Field Glazing: Closed-cell neoprene complying with ASTM C509, in black color or silicone if recommended by sealant manufacturer for compatibility with sealant.
 - 2. Provide manufacturer's standard accessories for factory-glazed units
- C. Glazing Tape: Butyl rubber type, black color; Pecora "Extru-Seal Tape G-66," Tremco "440 Tape," or accepted equal.
- D. Mirror Adhesive: "Mirro-Mastic" by Palmer Products Corp. or equal warranted for 5 years.
- E. Accessory Materials: Gaskets, miscellaneous clips, and fastenings as required and as standard with unit manufacturer.

2.7 FABRICATION

- A. Glazing framing dimensions shall provide for necessary minimum bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Provide correct glass size for each opening, within tolerances and necessary dimensions established.
- B. Factory-label each pane of glass. Do not remove labels until final acceptance is obtained.
- C. Tempered glass shall be horizontally tempered with roller ripples in horizontal direction.
 - 1. Where required, include an inconspicuous but visible permanent identifying label on each pane in accordance with ANSI Z97.1.
 - a. Fused to glass and located in a lower corner.
 - b. Include manufacturer's name or trademark, glass type, thickness, and designation of treatment.
 - 2. Maximum warpage in accordance with ASTM C1048.
 - 3. Provide fireman's tempered-glass marker where required by local fire department at exterior glazing.
 - 4. Provide cutouts for fittings and hardware where indicated.

- D. Insulating Glass: Certified under IGMA-approved program and meeting Test Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.
 - 1. Units shall be fabricated from glass materials as specified under Glass Types.
 - 2. Fabricate with warm-edge spacer.
- E. Dimensional Tolerances: Glass shall comply with referenced standards.
- F. Organic-Coated Mirrors: Provide backing tape on back of mirrors that are less than 36 inches above finished floor so as to keep glass fragments together should mirrors be accidentally shattered; "CRL" shatterproof safety tape as manufactured by C.R. Laurence Co., or equal.
 - 1. Taped mirrors shall comply with 16 CFR 1201, ANSI Z97.1 and CBC for impact testing as a Category I or II as required by installation.
 - 2. Grind smooth all exposed edges.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean glazing channels and framing members to receive glass immediately before glazing; remove coatings not firmly bonded to substrate.
- B. Apply primer to joint surfaces where recommended by sealant manufacturer.

3.2 GLAZING

- A. Comply with combined printed recommendations of glass manufacturers and manufacturers of sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Provide tempered glass at locations where indicated and required in accordance with the CBC.
- C. Protect glass from edge damage during handling and installation.
- D. Remove and dispose of glass with edge damage or other imperfections of any kind that, when installed, would weaken glass and impair performance and appearance.
- E. Install setting blocks of proper size at sill, located one-quarter of glass width from each corner, unless otherwise required. Set blocks in sealant acceptable for heel bead use.
- F. Provide edge blocking to comply with requirements of GANA "Glazing Manual," except where otherwise required by glass fabricator.
- G. Set units in each series with uniformity of pattern, draw, bow, and similar characteristics.
- H. Compression Gaskets: Provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
 - 1. Miter-cut at corners. Install as recommended by gasket manufacturer to prevent pull-away at corners.
 - 2. Seal corner joints and butt joints with sealant recommended by gasket manufacturer.
 - 3. Install gaskets to protrude slightly out of channel so as to eliminate dirt and moisture pockets.

- I. Mirror Adhesive: Apply in accordance with manufacturer's recommendations over primer/sealer on substrate.
 1. Do not apply over water-resistant gypsum board that has not been primed.
 2. Install to allow 1/8-inch space between back of mirror and surface of wall.
 3. Use metal clips to support unframed mirrors at lower edge. Do not rest mirrors directly on countertop backsplashes or tile.

3.3 PROTECTION AND CLEANING

- A. Do not apply markers to surfaces of glass.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.
- D. Remove nonpermanent labels, and wash glass on both faces by method recommended by glass manufacturer. Comply with the additional requirements of Section 01 7423, "Final Cleaning."

END OF SECTION

SECTION 08 9000
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed wall louvers and frames at exterior walls.
 - 2. Insect screens at louvers.
- B. Related Requirements:
 - 1. Sheet Metal Flashing and Trim: Section 07 6200; sill and other perimeter flashings at louver openings.
 - 2. Flexible Flashing and Underlayment: Section 07 6500.
 - 3. Joint Sealants: Section 07 9200.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Indicate louver layout plan and elevations; opening and clearance dimensions; tolerances; head, jamb, and sill details; blade configuration; screens; blank-out areas required; frames; and anchorage and interface with adjoining materials.
- B. Product Data: Manufacturer's installation instructions and descriptive data of louvers, including standard drawings and free area of louvers.
- C. Samples: 12-inch length of each louver blade, and full size or other appropriate sample of each vent, in specified finish.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's certification that louvers comply with requirements and are licensed to bear the AMCA seal, based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty.

1.6 QUALITY ASSURANCE

- A. Louvers shall meet requirements for HEVAC Certification for architectural louvers.

- B. Verify size, location and placement of louver units prior to fabrications, whenever possible.

1.7 FIELD CONDITIONS

- A. Verify that field measurements are as indicated on shop drawings.
- B. Coordinate with installation of exterior wall finish.

1.8 WARRANTY

- A. Manufacturer: Furnish Owner with manufacturer's 5-year warranty for louvers and metal finish against defects in materials and workmanship, including against delamination and pitting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Ruskin Company; 3900 Dr. Greaves Road, Kansas City, Missouri 64030. Tel: (816) 761-7476; or equal.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 6200, "Product Options and Substitutions".

2.2 STATIONARY BLADE LOUVER

- A. Model: L375D as manufactured by Ruskin Company.
- B. Fabrication: Stationary drainable type.
 - 1. Design: Drainable blades shall be contained within the frame with downspouts in jambs and mullions. Standard or flanged construction as scheduled or required.
 - 2. Frame:
 - a. Frame Depth: 4 inches.
 - b. Wall Thickness: 18 gage nominal.
 - c. Material: Roll formed galvanized steel.
 - 3. Blades:
 - a. Style: Drainable. 37-1/2 degree angle on 3-1/2 inches centers.
 - b. Wall Thickness: 18 gage, nominal.
 - c. Material: Roll formed galvanized steel.
 - 4. Size: as shown on drawings.
- C. Performance Data:
 - 1. Based on testing 48 inch x 48 inch unit in accordance with AMCA 500.
 - 2. Free Area: 51 percent, nominal.
 - 3. Free Area Size: 8.23 square feet.
 - 4. Maximum Recommended Air Flow Through Free Area: 961 feet per minute
 - 5. Air Flow: 7909 cubic feet per minute
 - 6. Maximum Pressure Drop (Intake): 0.10 inches w.g.

2.3 MATERIALS AND ADDITIONAL COMPONENTS

- A. Galvanized Sheet Steel: ASTM A526/A526M with ASTM A525, G90 zinc, coating, mill phosphatized.
- B. Fasteners: Hot-dip galvanized or stainless steel.

1. Provide types, gauges and lengths to suit unit installation conditions.
 2. Use Phillips flat- head machine screws for exposed fasteners, unless otherwise indicated.
- C. Insect Screen: 1/2 inch mesh x 19 gage galvanized steel, interior mounted in a re-wirable and removable frame. Attach to louvers with stainless steel screws, approximately 18 inches on center.
- D. Intermediate Mullions, if Required: Concealed, profile to suit louver frame.
- E. Blank-Off Panels, if Required: 20 gage (1 mm) galvanized steel sheet, factory installed with removable fasteners and neoprene gaskets.

2.4 FINISHES

- A. Exposed Steel:
1. Cleaning and Pretreatment. In accordance with AA-C12C42R1x.
 2. Prime Coat: As standard with manufacturer.
 3. Finish Coat: Manufacturer's high-performance fluoropolymer powder coating containing minimum 70 percent polyvinylidene fluoride (PVDF) resin and meeting or exceeding all the requirements of AAMA 2605.
 - a. Color: Custom to match metal wall panel.
- B. Screening: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check openings so as to assure that dimensions conform to Drawings.
- B. Ensure that openings are free of irregularities that would interfere with installation.

3.2 INSTALLATION

- A. Install louver assembly level and plumb as indicated on Drawings.
- B. Follow procedures in manufacturers recommended installation instructions.
- C. Install flashings and align louver assembly so as to ensure moisture shed from flashings and diversion of moisture to exterior. Coordinate installation with installation of head and sill flashing as specified in Section 07 6200, "Sheet Metal Flashing and Trim."
- D. Seal perimeter interior and exterior with sealant specified in Section 07 9200, "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. After initial inspection, remove labels, protective coating, and other foreign materials from aluminum surfaces.
- B. Field touch-up of factory-applied finish will not be allowed.

END OF SECTION

SECTION 09 2900

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board, including finishing.
 - 2. Metal accessories.
- B. Related Requirements:
 - 1. Access Doors and Panels: Section 08 3100.
 - 2. Acoustical Insulation and Sealants: Section 09 8200; acoustical sealants and sound control requirements.
 - 3. Painting and Coating: Section 09 9000.

1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C11 and GA-505 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's product data for the following system materials suitable to show compliance with requirements.
 - 1. Each type of board material.
 - 2. Metal accessories, if other than listed products are to be provided.
- B. Samples:
 - 1. Panels 10 inches square, on suitable backing, of specified texture finish.
 - a. Resubmit samples, as required, until finish desired by Architect is achieved.
 - b. One-half of panel shall have specified paint finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Statement of installer qualifications, if requested by Architect.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in work similar to that required on this Project, with not less than 5 years of documented experience.
- B. Notify Architect prior to covering or enclosing framing, ducts, and pipes in sound-rated construction in order to allow for on-site review and correction as required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in dry location, fully protected from weather, direct exposure to sunlight, and damage from other construction activity.
- B. Stack gypsum board products flat and level, properly supported in such a manner as to prevent sagging or damage to ends and edges.
- C. Store metal accessories so as to prevent bending, sagging, distortion, or other mechanical damage.
- D. Do not store or stack gypsum board on floors with an equivalent loading in excess of 50 pounds per square foot.
- E. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

- A. Ambient Conditions: Maintain temperature in installation area in accordance with GA-216 requirements. Provide supplemental heat as required to maintain minimum temperatures specified in GA-216.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Regulatory Requirements:
 - 1. Fire-Resistance Ratings:
 - a. Comply with fire-resistance ratings as indicated and required by governing authorities and codes.
 - b. Provide materials, accessories, and application procedures that have been listed by a nationally recognized testing agency or tested according to ASTM E119 for type of construction shown.
 - 2. Comply with the CBC.
- B. Industry Standards: Work shall comply with the applicable requirements of GA publication GA-216 and GA-214.

2.2 MATERIALS - GENERAL

- A. Products of specific manufacturers, when listed, are for quality and performance identification only. The listing is not intended to limit selection of similar products from other manufacturers.
- B. Provide products manufactured by or recommended by manufacturer of gypsum board in order to maintain single-source responsibility.
- C. Provide materials in accordance with ASTM C840.
- D. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board: ASTM C1396; USG "Sheetrock," or equal.

1. Thickness: 5/8 inch unless otherwise shown.
 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Impact Resistant Gypsum Board: ASTM C1278, USG "Fiberock Interior Panels, AR," or equal.
1. Thickness: 5/8 inch.
 2. Flexural Strength: Greater than 155 when tested in accordance with ASTM C473.
 3. Abuse-Resistance Performance: Complies with the following when tested in accordance with ASTM C1629.
 - a. Indentation Resistance: Level 1
 - b. Soft Body Impact: Level 2.
 - c. Hard Body Impact: Level 1.
- C. Fire Rated Gypsum Board: USG "Firecode," or equal.
1. ASTM C1396, Type X, unless more stringent type required by code.
 2. Thickness: 5/8 inch.
 3. Provide Type C at ceilings and were required by CBC or assembly.
- D. Fire-Rated Moisture- and Mold-Resistant Board: USG "Mold Tough Firecode Core," or equal.
1. ASTM C1396, Type X, unless more stringent required by code.
 2. Thickness: 5/8 inch.
 3. Mold Resistance: 10 on scale of 10 in when tested accordance with ASTM D3273.
 4. Moisture Resistance: The average water absorption for panels shall not exceed 5 percent by weight after two-hour immersion when tested in accordance with ASTM C473.
- E. Fire-Rated Impact and Mold Resistant Type "X" Gypsum Wallboard: ASTM C1629 and ASTM E119. USG "Mold Tough VHI Firecode Core Panels," or equal.
1. Thickness: 5/8 inch.

2.4 ACCESSORIES

- A. Adhesives:
1. Laminating Adhesive: As recommended by gypsum board manufacturer for laminating gypsum board together in fire-rated construction.
 2. Adhesives shall comply with required VOC regulations.
- B. Fasteners:
1. Screws: Phillips head with bugle shape, Type W, conforming to ASTM C1002.
 2. Sizes of fasteners shall be as required by code and as recommended by wallboard manufacturer.
- C. Concealed Metal Reinforcements and Casing: Electrogalvanized, conforming to ASTM C1047.
1. Exterior Corner: United States Gypsum (USG) "Dur-A-Bead," or equal.
 2. Intersection of Gypsum Board with Dissimilar Material: USG No. 200-B "L" shaped trim and 200-A "J" shaped trim, or equal.
 3. Control Joint: USG No. 093, or equal.
- D. Joint-Treatment Materials:
1. Manufacturer: Same as gypsum board.
 2. Comply with ASTM C475 and with manufacturer's recommendations for specific project conditions.
 3. Joint Tape: Manufacturer's standard paper type.
 4. Joint Compound: Vinyl-based, ready-mixed type for interior use and as follows:
 - a. Taping Compound: Specifically formulated for embedding tape and accessories and for prefilling.

- b. Topping Compound: Specifically formulated for finishing drywall over taping compound.
 - c. At joints and fasteners in moisture-and-mold-resistant gypsum board intended for tile surfacing, provide compound specifically recommended or permitted by manufacturer of board.
- E. Spray-on Texture Coating: USG "Texture XII Drywall Surfacer" or equal.
- F. Miscellaneous Items: Furnish components not specified but shown on the Drawings and other items required to complete the installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check framing for accurate spacing and alignment.
- B. Verify that spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.
- C. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.
- D. Repair protrusions of framing, twisted framing members, or unaligned members before starting installation of gypsum board.

3.2 APPLICATION OF GYPSUM BOARD

- A. General: Comply with ASTM C840, GA-216, and CBC. Where UL designs are indicated on the Drawings for fire-rated partitions, comply with UL requirements, except where exceeded by other requirements.
 - 1. Wherever possible, install gypsum board in such a manner as to minimize butt end joints.
 - 2. Apply ceiling boards prior to installation of wall boards. Arrange so as to minimize butt end joints near center of ceiling area.
 - 3. Install wall boards in such a manner as will minimize butt end joints in center of wall area. Stagger vertical joints on opposite sides of walls. Stagger horizontal joints where required by governing code.
 - 4. Butt all joints loosely with maximum of 1/16 inch between boards.
 - 5. Place wrapped edges adjacent to one another. Do not place cut edges or butt ends adjacent to wrapped edges.
 - 6. Support all edges and ends of each board on framing or by solid substrate, except that long edges at right angles to framing members in non-fire-rated construction may be left unsupported, unless required by governing code.
- B. Single-Layer Application:
 - 1. Install gypsum board by means of screw attachment.
 - 2. On walls and partitions, plan installation so that leading edge or end of gypsum board is attached to open end of stud flange first.
 - 3. Mark location of joists and studs. Do not locate screws attaching gypsum board to channels within 2 inches of joists or studs.
- C. Double-Layer Application:
 - 1. Apply base layer vertically, offsetting vertical joints at least one stud space between layers.

- a. Install base layer by means of screw attachment.
 - b. Provide fire taping only.
 2. Precut and fit face layer by laminating to base layer with adhesive.
 3. Provide temporary support for face layer, by fasteners or shoring, until adhesive is dry.
 4. At Contractor's option, provide permanent support by attaching face layer to base layer with screws in accordance with manufacturer's instructions.
- D. Metal Trim:
1. Apply trim at all exterior corners and at interior corners where gypsum board intersects metal or other dissimilar material.
 2. Install in longest lengths practicable.
 3. Run trim straight and square with all planes.
 4. Edges:
 - a. Apply applicable shape of metal edge trim at exposed edges of wallboard and where otherwise shown.
 - b. Gypsum Board Abutting Other Materials: Install edge trim with 1/8-inch clearance to allow for sealant.
 - c. Apply neoprene tape where shown to assure sealed joints at abutting surfaces.
 - 1) Install in longest lengths practicable.
 - 2) Adhere to edge trim prior to installation of trim.
 - d. Install retained flexible closure where partitions intersect at existing window wall framing.
 5. Apply metal corner beads at external corners in single lengths, unless details clearly indicate its omission at specific locations.
- E. Control Joints:
1. Provide control joints in accordance with ASTM C840 recommendations, where and where otherwise shown and specified.
 2. Location shall be approved by Architect.
- F. Remove and replace sheets damaged in handling or installation.
- G. For conditions not specified or shown on the Drawings, follow procedures recommended by the gypsum board manufacturer.
- H. Leave gypsum board in a clean condition, ready for taping and painting.

3.3 SOUND-RATED CONSTRUCTION

- A. Comply with requirements for sealing penetrations at sound-rated construction as specified in Section 09 8200, "Acoustical Insulation and Sealants."

3.4 FIELD QUALITY CONTROL

- A. Construction Tolerances:
1. Gypsum board surfaces to be painted shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8 inch in 10 feet 0 inches when a straightedge is laid on the surface in any direction.
 2. Shim work as required to comply with specified tolerances.
 3. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.

3.5 TAPING AND FINISHING

- A. Gypsum board partitions shall be appropriately prepared for finish indicated on the Drawings.

- B. General Requirements:
1. Apply finishing compounds in accordance with manufacturer's directions. Do not apply tape and joint compound over joints containing acoustical sealant until the sealant has completely cured.
 2. Center tape over joint, and embed in uniform layer of joint compound of sufficient width and depth to provide firm and complete bond.
 - a. Apply skim coat while embedding tape.
 - b. Apply second coat, where required by Level of Finish, after skim coat has hardened and been sanded.
 - c. Apply finish coat, and sand smooth, flush with adjacent surfaces.
 - d. Use appropriate water-resistant compound at moisture and mold resistant gypsum board filling all fastener heads, penetrations, and joints.
 3. Treat angles with reinforcing tape, folded to conform to adjacent surfaces and with straight, true angles.
 4. Provide minimum 24 hours' drying time between applications of compounds.
 5. Conceal flanges of metal reinforcement with minimum two coats compound. Compound shall extend 8 to 10 inches each side of metal nosing.
- C. Level of Finishes: In accordance with GA-214.
1. At Locations Indicated to Receive "Fire-Taping" and at Unexposed Gypsum Board Applications: Level 1.
 2. Surfaces to Receive Tile or Applied Paneling: Level 3.
 3. Restrooms: Level 4.
 4. Other Exposed Locations: Level 4 with Smooth Finish.
 - a. After splatter has set, create texture by knocking down with a smooth knife.
 - b. Texture shall be uniform and match accepted sample.

3.6 PROTECTION OF FINISHED WORK

- A. Provide proper procedures for protection of completed gypsum board from damage or deterioration until final acceptance of the Project.

END OF SECTION

SECTION 09 3000

TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain floor and wall tile.
 - 2. Grouting of tile.
 - 3. Crack-isolation membrane.
 - 4. Backer board.
- B. Related Requirements:
 - 1. Portland Cement Underlayment: Section 03 5415; materials for leveling concrete substrate to receive thinset floor tile.
 - 2. Joint Sealants: Section 07 9200.
 - 3. Toilet Accessories: Section 10 2813; recessed accessories at wall tile.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Contract Closeout," and Section 01 7800, "Project Records Documents."
- B. Pre-Installation Meeting: Contractor shall conduct a meeting prior to the start of tiling to review requirements in ANSI A108.01 for substrates, and to review custom layouts and preparation by other trades.
 - 1. Attendees shall include tile installer, Architect, and setting materials local representative.
 - 2. Notify participants at least 5 working days before conducting meeting.
 - 3. Record discussions of conference and any conflict, incompatibility, or inadequacy. Furnish a copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product literature for all manufactured products.
 - 2. Installation instructions for backer board, trim, and accessories.
 - 3. Installation instructions for manufactured setting and grouting products.
- B. Samples:
 - 1. Each color, size, and type of tile and grout specified and selected, mounted on plywood or hardboard backing, grouted.
 - a. Size: Varies based on tile size, but sufficient to show and intersecting grout joint.
 - b. For products with color and texture variation, submit sets showing full range of variations expected.
 - 2. Each type of edge trim and accessory, 6 inches long, in each color.

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of installer qualifications. Include list of completed projects with project names, addresses, and names of architects and owners.
- B. Test Reports: Certified laboratory or field tests for slip resistance as specified.
- C. Master grade certificates for each shipment, type, and composition of tile, signed by the manufacturer and installer.
- D. Record of pre-installation meeting.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty for setting and grouting products.

1.6 MAINTENANCE SUBMITTALS

- A. Furnish Owner with one full box of each color, size, and type of tile installed.
 - 1. Package in sealed, clean, marked cartons of the tile manufacturer.
 - 2. Boxes shall be identified by Room or area.
- B. Deliver maintenance materials to Owner as directed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Successful completion of tile installations similar in material, design, and extent to that required for this Project.
- B. Use the membrane, setting, and grouting products of a single manufacturer to insure compatibility and single source responsibility.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Ceramic Tile cartons shall be grade sealed by manufacturer in accordance with ANSI A137.1. Grade seals shall be unbroken.
- B. Manufactured setting and grouting materials shall contain hallmarks certifying compliance with reference standards.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.9 FIELD CONDITIONS

- A. Ambient Conditions: Comply with minimum temperature recommendations of manufacturers for bonding and grouting materials. If manufacturer has no recommendations, maintain temperature at not less than 50 degrees F during tile installation and for at least 7 days after completion of installation.

1.10 WARRANTY

- A. Manufacturer: Furnish Owner with the following warranties.
 - 1. Manufacturer of setting and grouting materials shall provide a written 5-year warranty for the installation, covering replacement of materials and labor.

2. Manufacturer of crack isolation materials shall provide a written warranty for not less than 10 years against defects in materials and workmanship including water leakage.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Slip Resistance: Floor tile shall provide a value equal to or greater than 0.42 when tested in accordance under dry conditions with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6, and under wet conditions with DCOF AcuTest procedure of ANSI B101.3. Laboratory tests shall be made on a minimum of three tiles of each material and finish proposed for use.
- B. Except where more stringent requirements are specified, conform to applicable ANSI Standards as follows:
 1. Ceramic Tile: ANSI A137.1 "Standard Grade."
 2. Tile Installation Materials: Comply with ANSI standard referenced with products and materials specified for setting and grouting.

2.2 TILE PRODUCTS

- A. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory, and package accordingly so that tile units taken from one package will show the same range of colors as those taken from other packages and will match accepted samples.
- B. Manufacturers: All products by the same manufacturer.
 1. Dal-Tile Corporation: www.daltile.com.
 2. Substitutions: See Section 01 6200, "Product Options and Substitutions".
- C. Unglazed Floor Tile (CT-1): ANSI A137.1 and as follows:
 1. Product: Unglazed porcelain floor tiles.
 2. Moisture Absorption: 0.0 to 0.05 percent.
 3. Size and Shape: As scheduled.
 4. Edges: Square.
 5. Surface Finish: Unglazed without abrasive admixture, coefficient of friction equal to or exceeding 0.6 wet.
 6. Colors: As scheduled.
 7. Trim Units (CT-3): Matching cove and base shapes in sizes coordinated with field tile.
- D. Glazed Wall Tile (CT-2): ANSI A137.1 and as follows:
 1. Product: Glazed porcelain wall tile.
 2. Moisture Absorption: 0.0 to 0.5 percent.
 3. Size and Shape: As scheduled.
 4. Edges: Square.
 5. Surface Finish: Glazed.
- E. Trim Shapes (CT-3)
 1. Provide cove base, bullnose, returns, trimmers, and other shapes, as available for scheduled tiles to finish installation and as indicated on the Drawings.
 2. Color and finish of trim shapes shall match adjacent tile. Base shall match wall tile or floor tile as scheduled.

2.3 CRACK ISOLATION AND UNDERLAYMENT MATERIALS

- A. Liquid-Applied Waterproofing and Crack Isolation Membrane: "Hydro Ban" by Laticrete, "Redgard" by Custom Building Products, or equal meeting ANSI A118.12 for crack isolation membranes and ANSI 118.10 for waterproofing membranes.
- B. Cementitious Backer Board: ANSI A118.9; "Durock" by U.S. Gypsum, as specified and basis of design, or equal.
 - 1. Thickness: 5/8 inch,
 - 2. Fasteners: Rust-resistant drywall screws.

2.4 SETTING MATERIALS

- A. Latex Portland Cement Mortar: ANSI A118.4; "254 Platinum" by Laticrete", or accepted equal.
- B. Other Acceptable Manufacturers:
 - 1. Mapei Corporation; Product Keraset: www.mapei.com. a.
When used with porcelain tile, mix with Keraply.
 - 2. Bostik, Inc; meet ANSI A118.1 and ANSI A118.4: www.bostik-us.com.
 - 3. Substitutions: See Section 01 6200, "Product Options and Substitutions".

2.5 GROUTING MATERIALS

- A. Epoxy Grout: ANSI A118.3; "SpectraLOCK PRO" by Laticrete, or accepted manufacturers as above.
- B. Grout Colors: As selected by the Architect from manufacturer's available standard and premium colors.

2.6 ADDITIONAL MATERIALS

- A. Sealant: As provided by grout manufacturer.
 - 1. Color: To match color of grout in adjacent joints.
 - 2. Provide sanded or nonsanded type as required to match type of grout.
- B. Water: Clean and potable.
- C. Tile Cleaner: Product specifically acceptable to tile manufacturer and grout manufacturer for application intended and as recommended by National Tile Promotion Federation (NTPF) for Ceramic Tile Institute (CTI).
- D. Protective Paper: Non-staining laminated and reinforced Kraft paper with bituminous or latex binder.
- E. Provide primers and other products recommended by manufacturers of setting materials or required for a complete installation.

2.7 MIXING MORTAR AND GROUT

- A. Prepare and proportion premixed setting beds and grout materials in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive ceramic tile, setting beds, or accessories for defects or conditions adversely affecting quality and execution of tile installation.
 - 1. Surfaces shall be firm, dry, clean, and free of oily or waxy films.
 - 2. Grounds, anchors, plugs, hangers, bucks, and electrical and mechanical work in or behind tile shall be installed prior to proceeding with tile work.
- B. Allowable Tolerances of Surfaces to Receive Tile:
 - 1. Maximum Variation in Vertical Surfaces: 1/8 inch in 8 feet.
 - 2. Maximum Variation in Horizontal Surfaces: 1/8 inch in 10 feet.

3.2 PREPARATION

- A. Protect adjoining work surfaces before tile work begins. Close spaces in which tile is being set to traffic and other work. Keep closed until firmly set.

3.3 INSTALLATION OF FLUID-APPLIED CRACK ISOLATION MEMBRANE

- A. Install membrane in accordance with ANSI A108.13, manufacturer's instructions for a crack isolation and waterproofing membrane, and to effect specified warranty.
- B. Apply a liberal coat liquid membrane to assure a uniform film thickness.
- C. Periodically check the film thickness with a wet-film gauge.
- D. Apply a second coat at right angles to the first to assure a total final dry film thickness of not less than 20 mils.
- E. Provide fabric reinforcing at drains, changes of plane and, and at gaps 1/8 inch and greater.
- F. Installation shall be reviewed by Architect before installation of overlying materials.

3.4 TILE INSTALLATION - GENERAL

- A. Except as otherwise specified, work shall conform to the recommendations and listed installation methods included in the "Handbook for Ceramic, Glass, and Stone Tile Installation" published by the Tile Council of North America, Inc.
- B. Laying out Tile Work:
 - 1. Lay out tile work so that, insofar as possible, no tile less than half full size occurs.
 - 2. Lay floor areas out from center lines so that all major adjustments are made at walls and perimeter of tiled areas.
 - 3. Lay out wall tiles so that fields and patterns center exactly on individual wall areas.
 - 4. Align joints in both directions.
- C. Cutting of Tiles:
 - 1. Cut and drill without marring tile.
 - 2. Rub cuts smooth with a fine abrasive stone.
 - 3. Set no cut edge against any fixture, cabinet, or other tile without a joint at least 1/16 inch wide.
 - 4. Whenever possible, turn cut to inside corner.

5. Fit tile around electric outlets, plumbing pipes, fixtures, and fittings close enough to permit standard plates and collars to overlap tile.
- D. Sound tile after setting. Remove and replace hollow-sounding units.
- E. Allow tile to set at least 48 hours prior to grouting.
- F. Grout tile to comply with requirements of ANSI A108.10.
- G. Joint Sealants:
 1. Install sealant in perimeter joints and around floor drains and penetrations.
 2. Comply with installation requirements for sealants specified in Section 07 9200, "Joint Sealants."
 3. After curing, remove spacers, and dry and clean all joints requiring sealant.

3.5 INSTALLATION METHODS

- A. Prepare surface, fit, set or bond, grout, and clean in accordance with applicable requirements of ANSI standards for setting method specified.
- B. Wall Tile: TCNA Method W244.
 1. Install cement backer board over framing in accordance with ANSI A108.11.
 - a. Horizontal and vertical joints shall have a 1/8-inch space, filled with latex Portland cement mortar.
 - b. Embed 2-inch glass-fiber-mesh tape in skim coat of mortar at joints.
 2. Thin-set wall tile over cement backer board, using latex portland cement mortar in accordance with ANSI A108.5.
 3. Install epoxy grout as specified.
- C. Floor Tile: TCNA Method F125-Full.
 1. Install crack isolation membrane over concrete as specified turning up wall a minimum of 6 inches. Coordinate installation of a suitable backing with other Sections.
 2. Coordinate with installation of threshold at transitions to adjacent flooring material.
 3. Thin-set tiles over membrane in bond coat of specified latex portland cement mortar in accordance with ANSI A108.5.
 - a. Exercise care so as to avoid damage to membrane.
 - b. Use medium bed mortar if thickness will exceed manufacturer's recommendations for thinset mortar at areas sloped to drain.
 4. Install epoxy grout as specified.
- D. Control, Contraction, Construction, and Isolation Joints:
 1. Locate joints, and install in accordance with TCNA Method EJ171.
 2. Provide where tile abuts restraining surfaces in such locations as perimeter walls, dissimilar floors, and where changes occur in backing materials.

3.6 ADJUSTMENT AND CLEANING

- A. Remove cracked, stained, discolored, broken, or damaged tile. Replace with new tile.
- B. Clean tile surfaces as thoroughly as possible on completion of grouting.
- C. Remove grout haze, observing grout manufacturers' recommendations as to use of acid and chemical cleaners.

- D. Rinse tile work thoroughly with clean water before and after using chemical cleaners.
- E. Use no acids or abrasive soaps on tile, except as approved by tile manufacturer.

3.7 CURING, PROTECTION AND FINISHING

- A. Floor Tile:
 - 1. Curing and Protection:
 - a. Apply protective paper over floor tile as soon as pointing and grouting and cleaning are completed.
 - b. Lap sheets at least 4 inches, and seal laps against escape of moisture.
 - c. Leave curing paper in place until job is ready for final cleaning.
 - d. Do not permit cement grouts to dry out until cured at least 72 hours.
 - 2. Keep traffic off floors during the curing period (7 days).
 - 3. Final Cleaning: Just before final acceptance of tile work, remove paper, and reclean surfaces, and apply applicable sealer in accordance with manufacturer's instructions.
- B. Wall Tile:
 - 1. If recommended by tile manufacturer, apply a protective coat of neutral cleaner solution, one part cleaner to one part water, to all clean, completed tile walls after grout has cured.
 - 2. Just before final acceptance of tile work, rinse protective coat of neutral cleaner from all tile surfaces.

END OF SECTION

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SECTION 09 5100

ACOUSTIC TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Suspended acoustical ceiling panels.
 - 2. Ceiling suspension system.
 - 3. Adhesively-applied acoustical ceiling tiles.
- B. Related Requirements
 - 1. Acoustical Wall Panels: Section 09 8319.
 - 2. Heating, Ventilating, and Air-Conditioning (HVAC): Division 23; air diffusers.
 - 3. Electrical: Division 26; lighting fixtures.
 - 4. Ceiling Details and DSA Interpretation of Regulations (IR) included on the Drawings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Coordination:
 - 1. Develop and coordinate locations of work supported by or penetrating through ceiling with the other Sections involved prior to making shop drawing submittal. In particular, note partitions that are to be installed prior to ceiling installation.
 - 2. Coordinate work with items specified under other Sections.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Include the following:
 - 1. Layout of suspension system and location of hangers, clips, seismic braces, and trapezes.
 - 2. Inserts and hanger and clip fastening details.
 - 3. Trapeze details.
 - 4. Splicing method for main and cross runners.
 - 5. Support of ceiling fixtures and air diffusers, and support of adjacent acoustical panels.
 - 6. Details at changes in ceiling level.
 - 7. Locations and dimensions of access doors, light fixtures, supply and exhaust grilles and diffusers, sprinkler heads, speakers, detection devices, and all other items to be installed in suspended acoustical ceilings.
 - 8. Pattern of mechanical fasteners where used in an exposed location.
 - 9. Seismic control details.
- B. Product Data: Manufacturer's catalog cuts for new and replacement suspension system components and acoustical panels.
 - 1. Data sheets shall be marked to identify specific products proposed for use.
 - 2. Include ICC-ES Report for seismic clips.
- C. Samples:

1. Full-size 6-inch x 6-inch sample of each type of acoustical panel required.
2. 8-inch-long sample of each type of exposed suspension member and trim, showing profile and finish.

D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.

1.4 MAINTENANCE SUBMITTALS

A. Acoustical Units: Furnish extra material equal to two full cases of the material manufacturer for each acoustical panel product provided on the Project.

B. Deliver and store in accordance with instructions provided by the District.

1.5 CLOSEOUT SUBMITTALS

A. Warranties as specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of three installations of extent comparable to Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver with manufacturers' labels indicating brand name, pattern, size, thickness.

B. Store cartons open at each end to stabilize moisture content and temperature.

C. Do not begin installation until sufficient materials to complete a room are received.

D. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

A. Ambient Conditions, Unless Otherwise Acceptable to Material Manufacturer:

1. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, and dust-generating activities have been terminated.
2. Maintain a uniform temperature between 55 and 70 degrees F prior to and during installation of materials.

B. Do not install acoustical ceilings until work above ceilings is completed, including testing and approval of mechanical work.

C. Notify District's Representative, in writing, of any conditions preventing proper application of acoustical ceilings.

1.9 WARRANTY

A. Manufacturer: Furnish District with the following extended product warranties from manufacturer.

1. Acoustical Panels: 10 years.
2. Suspension Grid: 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Acceptable Manufacturers:
 - 1. Basis of Design - Armstrong World Industries, Inc: www.armstrongceilings.com.
 - 2. USG: www.usg.com.
- B. Products of other manufacturers will not be considered for substitution.

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. Ceilings shall comply with CBC requirements for seismic bracing of ceiling suspension system.
- B. Fire Performance Characteristics:
 - 1. Surface Burning Characteristics: Provide products complying with ASTM E 1264 for Class A products and meeting the following when tested in accordance with ASTM E84.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
- C. Tolerances:
 - 1. Deflection, ASTM C635: Maximum 1/360 of span. Applies to suspension system components, hangers, clips, and fastening devices supporting light fixtures, ceiling grilles, and to acoustical panels.
 - 2. Allowable Tolerance of Finished Acoustical Ceiling System: Level within 1/8 inch in 12 feet.

2.3 SUSPENSION AND GRID FRAMING

- A. Comply with ASTM C635.
- B. Structural Classification: Heavy-duty.
- C. Main and Cross Members: Hot-dip galvanized, cold-rolled steel.
- D. Grid Edge Moldings:
 - 1. Perimeter at Interface with Vertical Surfaces: Hot-dip galvanized, cold-rolled steel, minimum 0.020-inch-thick steel.
 - a. Typical Profile: Channel or angle, minimum flange width of 15/16 inch.
 - b. Shadow-Line Profile, if shown: Armstrong #7873, or equal.
 - 2. Exposed Floating Edge Molding, if shown: Extruded aluminum with factory-applied baked enamel finish; Armstrong "Axiom Knife Edge" or equal.
 - a. Heights: As shown on the Drawings.
 - b. Color: To match ceiling panel, unless otherwise indicated.
- E. Splices, End Connections, Clips, and Other Accessories: Hot-dip galvanized steel.
 - 1. Hold-Down Clips: Concealed, spring-loaded, fully accessible.
 - 2. Design to provide strong, rigid, lock-type connections preventing movement or displacement of joined components and permitting disassembly without damage to component parts.
 - 3. Perimeter Seismic Clips: Armstrong "Berc2 Clip" at perimeter, or equal, and in accordance with ICC-ES Evaluation Report.
 - 4. Direct Attachment Clips: "QuikStix" by Armstrong World Industries, or equal.

- F. Suspension Wire: ASTM A641, Class 1 zinc coating, soft temper.
 - 1. Hanger Wire: 0.106-inch nominal diameter (12 gage).
 - 2. Bracing Wire: 0.120-inch nominal diameter (10 gage).
- G. Attachment Devices: Size for five times design load required by ASTM C635, Table 1, Direct Hung, unless otherwise indicated.
- H. Compression Struts: Donn "Seismic Compression Post" or accepted equal manufactured proprietary product conforming to specified requirements and those indicated on the Drawings.
- I. Finish:
 - 1. Steel components shall be Bonderized and given a coat of rust-inhibitive paint.
 - 2. Exposed surfaces of components shall have factory-applied semi-gloss white enamel finish, unless otherwise noted.
 - 3. Grid Color: White, unless otherwise specified.
- J. Suspension, Attachment, and Grid Types: As specified under Article 2.6 below.

2.4 ACOUSTICAL PANELS

- A. ACP-1:
 - 1. Grid: Direct-hung, exposed tee grid, 15/16 inch face, white color; "Prelude XL" by Armstrong, or equal.
 - a. Color: White.
 - 2. Lay-in Panels: 24 inches x 48 inches x 7/8 inch thick mineral fiber, "Cirrus High NRC 551" by Armstrong World Industries, or equal complying with the following.
 - a. Edge: Angled Tegular.
 - b. Texture: Medium.
 - c. Finish: Factory-applied latex paint.
 - d. Light Reflectance: 0.85 percent.
 - e. Color: White.
 - f. Acoustical Performance: ASTM E413.
 - 1) NRC: 0.75.
 - 2) CAC: 35.
 - g. Fire Rating: Class A in accordance with ASTM E84.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUSPENDED ACOUSTICAL PANEL CEILINGS

- A. Pattern shall be approved by District's Representative before installation of suspension system.
- B. Install suspension system, including necessary hangers, clips, grillage, and other supporting hardware in accordance with CBC, ASTM C636 and ASTM E580, manufacturer's instructions, and as specified. The most stringent requirements shall govern.
 - 1. Hangers:
 - a. Coordinate hanger locations with other work. Hanger wire attachment devices shall be capable of supporting 100 pounds.
 - b. Ensure that hangers and carrying channels are located to accommodate fittings and equipment that are to be placed after installation of ceiling grid system.
 - c. Space hanger wire as required by CBC and latest edition of DSA IR 25-2.13 for specified wire gage.

- d. Install additional hangers at ends of each suspension member, at light fixtures, and 6 inches from vertical surfaces.
 - e. Do not splay wires more than 5 inches in a 4 foot vertical drop.
 - f. Wrap wire as shown on the Drawings.
 - g. Provide trapeze suspension or other appropriate system for suspension of ceiling system and light fixtures at large ductwork.
 - h. Provide two extra tie wires at each light fixture and HVAC register for use in tying off opposite corners at fixtures and registers.
 - i. Kinks and bends are not permitted in hanger wires to level carrying channels.
2. Main Runners:
 - a. Space main runners at 4 feet on center.
 - b. Level and square to adjacent walls.
 - c. Independently support a maximum of 8 inches from each wall.
 - d. Secure to structure above with four-way, bracing wire splays as specified and shown on the Drawings.
 3. Space cross runners at 2 feet on center.
 - a. Independently support if 8 inches or more from wall.
 4. Use standard "Tee" section at grid change in direction.
 5. Wall and Perimeter Moldings:
 - a. Install wall molding at intersection of suspended ceiling and vertical surfaces.
 - b. Miter corners where wall and perimeter moldings intersect.
 - c. Attach to vertical surface with concealed mechanical fasteners.
 6. Seismic Bracing Assembly: Comply with requirements shown on the Drawings and the following.
 - a. Horizontal Restraints: 4 splayed wires oriented 90 degrees from each other.
 - 1) Splices in bracing wires are not permitted.
 - 2) Angle of wires shall not exceed 45 degrees from the plane of the ceiling.
 - b. Vertical Restraints:
 - 1) Comply with requirements shown on the Drawings.
 - 2) Compression struts shall not replace hanger wires.
 - c. Lateral force bracing is not required at ceiling areas less than 144 square feet that are surrounded by walls extending to structure above.
 - d. Ceiling areas exceeding 2,500 square feet shall have a seismic separation joint with each area provided with closure angles.
 - e. Seismic perimeter clips shall have current and approved ICC-ES Report and shall be installed in accordance with the details and recommendations of the Report.
 - f. Provide spreader bars at all main and perimeter runners.
- C. Lay-in Acoustical Panels:
1. Install in grid system in accordance with manufacturer's recommendations and procedures in Cisca publication "Acoustical Ceiling Use and Practice." CBC shall govern if in conflict or more restrictive than Cisca publication.
 2. Install in level plane in straight line courses.
 3. Apply with grain, if any, in same direction, not checkerboard.
 4. Minimum Width of Border Panel: One-half panel dimension, unless indicated on the Drawings or approved submittals.
 5. Provide trim molding at recessed troffer lights as required.
 6. Hold-Down Clips:
 - a. Acoustical panels surrounding recessed troffer lights shall be installed with hold-down clips to prevent movement or displacement of panels.
 - b. Provide hold-down clips at perimeter where grid meets wall molding.
 - c. Exposed fasteners are not acceptable.
 7. Coordinate lay-in system with electrical fixtures and mechanical work that will be integrated with the ceiling.

- D. Ceiling Mounted Light Fixtures and HVAC Terminals:
1. Secure with mechanical fasteners to the ceiling grid runners to resist a horizontal force equal to the weight of the fixture.
 2. Independently support with wires to structure above as follows:
 - a. Fixtures Less than 10 Pounds: One 12-gage wire from the fixture housing. This wire may be slack.
 - b. Fixtures Between 11 and 55 Pounds: Two 12-gage wires attached to fixture and structure above. These wires may be slack.
 - c. Fixtures 56 pounds and more shall be independently supported using 9-gage wire:
 3. Fasteners shall be concealed in completed installation.

3.2 INSTALLATION OF DIRECTLY ATTACHED ACOUSTICAL PANELS CEILINGS

- A. Preparation:
1. Pattern and layout shall be approved by District's Representative before beginning installation.
 2. Test and verify that moisture level of concrete is below tile manufacturer's recommended limits.
 3. Wipe and prime ceiling.
- B. Adhesive Installation: Install acoustical tile by bonding to substrate, using acoustical tile adhesive and procedure recommended in writing by tile manufacturer and as follows:
1. Complete tile work shall present smooth, level or plumb surface free from unevenness, edge or corner offsets, cupping, scratches, broken tile or other imperfections.
 2. Coordinate work with other trades in providing openings, such as for lighting fixtures, ventilating fixtures, and access doors.
 3. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures and penetrations.
- C. Perimeter Wall Molding:
1. Provide specified perimeter wall molding at entire perimeter edge of glue-on acoustical tile ceilings.
 2. Perimeter wall molding edge of glue-on acoustical ceiling tile installation shall be held off vertical faces of adjacent walls by 1-1/2 inches in order to provide perimeter shadow line around entire area of installation unless otherwise shown.
- D. Adhesive: Comply with the following unless otherwise recommended by tile manufacturer.
1. Spots of adhesive, 1-1/4 inches diameter minimum, shall be placed at corners; the tile pressed and slid into place using spline making sure that face surface is aligned and leveled.
 2. Use sufficient adhesive to permit adjusting tile to uniform true plane without irregularities.
- E. Leveling Spline: Install alignment and leveling splines at four corners.

3.3 CLEANING

- A. Clean soiled or discolored surfaces after installation.
- B. Touch up scratches, abrasions, voids, and other defects in painted surfaces.
- C. Remove and replace damaged or improperly installed work.

END OF SECTION

SECTION 09 6120

CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Clear sealer applied to exposed interior concrete at locations not scheduled to receive applied flooring material.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for each type of steel stud as may be required to show compliance with specified requirements.
- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Results of field slip-resistance testing.

1.5 QUALITY ASSURANCE

- A. Mockup: Select an appropriate area, in coordination with the Architect, as a test area to evaluate application procedure and appearance.
 1. Document application rate used for test area.
 2. Allow 5 to 7 days after application before evaluating test area.
 3. Evaluation of test area will be used to determine if more than one coat will be required.
 4. Mockup may be used for testing slip resistance.
 5. Comply with additional requirements of Section 01 4339, "Mockup Requirements."

1.6 FIELD CONDITIONS

- A. Coordinate finishing of exposed concrete flatwork to receive sealer with surface textures specified under other Sections. A finished surface with specified slip-resistance as specified is required.
- B. Protect exposed surfaces, both new concrete flat work and concrete where surface treatment is completed, to prevent damage by impact or stains from rubbish and the work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sealing Compound at Exposed Concrete Flatwork: Low VOC, exempt solvent-based, non-yellowing, complying with ASTM C309, Type 1, Classes A & B; "Diamond Clear 350" by Euclid Chemical Company, or equal.

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. Slip Resistance: Walking surface, after application of sealer, shall provide a value equal to or greater than 0.42 when tested in accordance under dry conditions with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6, and under wet conditions with DCOF AcuTest procedure of ANSI B101.3.
 - 1. Individual tests shall be made for each contiguous area.
 - 2. Test results shall be reported in writing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. When applying to freshly poured concrete as a cure and seal, the surface bleed water must be allowed to evaporate prior to applying sealer and the surface must be hard enough as to not be marred during product application.
- B. When applying over cured concrete, sealer shall not be applied over stains, layout markings, oils, grease, wax, and other contamination caused by Contractor's construction activities.
 - 1. Stains, layout markings, and contamination shall be thoroughly removed by the use of detergent scrubbing with a heavy duty cleaner/degreaser, low pressure water cleaning (less than 5,000 psi), steam cleaning, or chemical cleaning.
 - 2. If cleaning does not achieve an acceptable surface and remove contamination, provide additional surface preparation as approved by the Architect.

3.2 APPLICATION OF CLEAR SEALER

- A. Apply specified sealer using an industrial, solvent-resistant pump-up sprayer with a high-solids nozzle and a short-nap, solvent-resistant roller for even distribution in accordance with manufacturer's instructions.
- B. Maintain a "wet edge" while spraying, and immediately backroll over sprayer lap marks.
- C. Redistribute puddles and runs before sealer dries.
- D. Apply uniformly and with sufficient material for surface to remain wet for 30 to 60 seconds before penetrating.
- E. Do not exceed manufacturer's recommended application rate.
- F. Apply second coat required to achieve appearance and sealing properties acceptable to Architect as determined during review of mockup.

3.3 PROTECTION

- A. Protect exposed surfaces, as required to prevent damage by impact or stains from rubbish and work of other trades.

END OF SECTION

SECTION 09 6500

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient tile flooring.
 - 2. Resilient base.
 - 3. Resilient edge trim and accessories.
- B. Related Requirements:
 - 1. Concrete Moisture Testing: Section 01 4520.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical data for each resilient product required.
 - 1. Include profiles of resilient edge strips and reducers.
 - 2. Include laboratory tests reports for flooring products showing compliance with specified slip resistance.
- B. Samples:
 - 1. Tile: Full size for each type, color, and pattern.
 - 2. Base and Accessories: 9 inches long by full dimension for each profile.
- C. Sustainable Design: Information necessary to establish and document compliance with the California Green Building Standards Code (CALGreen) goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Results of substrate moisture content tests.

1.5 MAINTENANCE SUBMITTALS

- A. Furnish additional floor-covering materials for replacement and maintenance. Furnish, in factory-packaged and -labeled cartons.
 - 1. Tile: 1 full carton in size, color, and pattern installed.
 - 2. Base: Not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, profile, and size installed.
- B. Supply extra materials from same production lots and color runs as used in work.
- C. Deliver the extra material to Project and store as directed by District.

1.6 CLOSEOUT SUBMITTALS

- A. Extended product warranties from manufacturers.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: At least three installations of extent comparable to this Project.
- B. Mockups:
 - 1. First installed area or example of flooring and base shall serve as a mockup for review and approval by District's Representative of workmanship, visual effect, and interface with adjacent construction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements specified in Section 01 6000, "Product Requirements."

1.9 FIELD CONDITIONS

- A. Ambient Conditions:
 - 1. Maintain temperature in spaces to receive resilient flooring between 70 and 90 degrees F for at least 24 hours before installation, during installation, and 48 hours after installation.
 - 2. Allow flooring and base to acclimate to ambient conditions. Store in spaces where they will be installed for at least 48 hours before beginning installation.
 - 3. Maintain minimum temperature of 55 degrees F for remainder of construction period.
 - 4. Do not install flooring when relative humidity exceeds 45 percent.
- B. Install resilient flooring products after other finishing operations, including painting, have been completed.

1.10 WARRANTY

- A. Manufacturer: Furnish District with manufacturer's written warranties as available for the resilient flooring products installed.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Slip Resistance: Flooring, after application of any specified finishes, shall provide a value equal to or greater than 0.42 when tested in accordance with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6.

2.2 RESILIENT MATERIALS

- A. Linoleum Tile (LIN-1): EN-ISO 10874, Class 34, 50cm x 50cm x 2.5mm thick; Forbo Marmoleum Modular, or equal.
 - 1. Colors: As scheduled.
- B. Resilient Base (RB-1): ASTM F1861, Type TP, vulcanized rubber; BurkeMercer, as scheduled, Johnsonite by Tarkett, or equal.
 - 1. Lengths: Roll.
 - 2. Profile: Coved at concrete and other hard surfaces.
 - 3. Height: 6 inches, unless otherwise shown.

4. Colors: As scheduled.
 5. Provide premolded external corners ordered from same color run as base.
 6. Flammability:
 - a. Critical Radiant Flux: Class I when tested in accordance with ASTM E648.
 - b. Smoke Density: Less than 450 when tested in accordance with ASTM E84.
- C. Edge Strips: Molded vinyl; BurkeMercer as shown and specified, Roppe, or equal.
1. Profiles: As shown on the Drawings.
 2. Colors: To be selected by Architect.

2.3 INSTALLATION ACCESSORIES

- A. Adhesives: Provide type and brands of VOC compliant, water-resistant adhesive as recommended by manufacturer of resilient flooring material for conditions of installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect substrate in order to verify that it is satisfactory. Substrate shall be:
1. Free of excess moisture, as determined by testing.
 2. Smooth and free of cracks, holes, ridges, coatings preventing adhesive bond.
 3. Free of other defects impairing performance or appearance.
- B. Suitability of Substrate:
1. Concrete surfaces shall be subject to moisture content testing as specified in Section 01 4520, "Concrete Moisture Testing," to verify concrete is within limits of the respective flooring manufacturer.
 2. Substrate shall be flat to within 3/16 inch in 10 feet and shall be such that finish floor will not show "telegraphing" of irregularities.
 3. Perform bond tests to ascertain presence of substances detrimental to obtaining adhesive bond.
- C. Flooring material shall be visually inspected prior to installation.
1. Do not use material with visual defects.
 2. Verify flooring material is from the same batch number (dye lot).

3.2 PREPARATION

- A. Comply with ASTM F710 and manufacturer's recommendations for surface preparation.
1. Use leveling and patching compounds, as recommended by resilient flooring manufacturer, for filling small cracks, holes, and depressions in subfloor to within specified tolerances and criteria.
 2. Remove protrusions, and grind smooth.
 3. Remove coatings that might prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives.
 4. Steel troweled concrete shall be properly roughened-up (sanded) to ensure suitable adhesion.
 5. Vacuum surfaces to be covered.
- B. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.3 APPLICATION OF ADHESIVES

- A. Mix and apply adhesives in accordance with manufacturer's instructions. Prime surfaces if recommended by adhesive manufacturer.
- B. Apply uniformly over substrates.
 - 1. Cover only that amount of area that can be covered by flooring material or base within the recommended working time of adhesive.
 - 2. Remove any adhesive that dries or films over.
 - 3. Do not soil walls, bases, or adjacent areas with adhesive.
 - 4. Promptly remove any spillage.
- C. Apply adhesives with notched trowel or other suitable tool.
- D. Clean trowel, and rework notches as necessary to ensure proper application of adhesive.

3.4 INSTALLATION OF TILE FLOORING

- A. Lay tile from center of room or space, working toward perimeter.
 - 1. Lay tile parallel to room axis in straight courses, with cross joints perpendicular and straight.
 - 2. Lay tile with grain or pattern running in checkerboard pattern or in same direction, as directed by District's Representative.
 - 3. Do not lay tile less than one-half width of a field tile, except where accepted by District's Representative for irregularly shaped rooms or spaces.
- B. Fit tile neatly and tightly into breaks and recesses, against bases, around pipes and penetrations, under saddles or thresholds, and around permanent cabinets and equipment. Cut tile neatly and accurately to fit within 1/64 inch of abutting surfaces.

3.5 INSTALLATION OF BASE AND EDGE STRIPS

- A. Wall Base:
 - 1. Install base around perimeter of room or space at base of partitions, columns, and other permanent fixtures where scheduled.
 - 2. Unroll base material, and let relax.
 - 3. Cut into accurate lengths as required for minimum number of joints.
 - 4. Apply adhesive, and firmly adhere to wall surfaces.
 - 5. Press down so that bottom cove edge follows floor profile.
 - 6. Unless otherwise dictated by length of wall, comply with the following:
 - a. Locate end of runs not less than 36 inches from a corner.
 - b. Do not use pieces less than 6-foot long except where required by wall length.
 - 7. Corners:
 - a. Use premolded corners for external corners.
 - b. Miter internal corners.
 - 8. Scribe base accurately to abutting materials.
- B. Edge Strips:
 - 1. Apply adhesives, and bond securely to substrates in straight, true lines.
 - 2. Provide where resilient flooring terminates, exposing edge of covering.
 - 3. Center edge strips under doors where resilient flooring terminates at a door opening.
 - 4. Top of strips shall be flush with top of resilient flooring.
 - 5. Install reducer strips where required to provide smooth transition between resilient flooring and other finish.

3.6 FINISHING AND CLEANING

- A. Clean approximately 72 hours after installation, or after adhesives have cured and after completion of adjacent work, as recommended by manufacturer for type of flooring installed.
 - 1. Sweep or vacuum floor thoroughly.
 - 2. Clean surfaces with a neutral cleaner.
 - 3. Remove excess adhesive and other surface blemishes, using appropriate recommended cleaner.

- B. Protect flooring against damage and from normal wear and tear during construction period, in accordance with flooring manufacturer's directions, so that flooring will remain without indication of use or damage.
 - 1. Protect flooring against rolling loads by covering with plywood or hardboard.
 - 2. Use dollies to move stationary equipment or furnishings across floors.

END OF SECTION

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SECTION 09 6723
RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resinous floor coating system and base.
 - 2. Vapor control primer.
- B. Related Requirements:
 - 1. Concrete Moisture Testing: Section 01 4520.
 - 2. Joint Sealants: Section 07 9200.
 - 3. Division 22: Plumbing; floor drains installed flush with resinous flooring.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Contract Closeout," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Joint strip and expansion joint layout and details. Show relationship with adjacent finish materials, adjacent construction, and building structure.
- B. Product Data: Manufacturer's recommended installation details, installation procedures, and maintenance procedures.
- C. Samples: 6 inches square in specified color.
- D. LEED Submittals:
 - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, submit documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
 - b. Include LEED Product Information Form for LEED Credits MR 4.1 and 4.2.
 - 2. Product Data for Credit EQ 4.2: For field applied, interior, paints coatings and primers, include printed statement of VOC content indicating compliance with Credit requirements.
 - a. Include LEED Product Information Form for LEED Credit EQ 4.2.
 - 3. Provide additional documentation for products as required to achieve each Credit(s)

1.4 INFORMATIONAL SUBMITTALS

- A. Installer qualifications.
- B. Plan for curing flooring.
- C. Field Test Reports:

1.5 CLOSEOUT SUBMITTALS

- A. Specified warranties.
- B. Manufacturer's cleaning and maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer-trained crew of skilled workers. Installer shall have documented experience installing products of type specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aggregates in bags identified with type and size of aggregate.
- B. Store materials in a clean, dry, protected location.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

- A. Ambient Conditions: Maintain ambient and substrate temperature and moisture content as recommended by manufacturer.

1.9 WARRANTY

- A. Manufacturer: Furnish District with manufacturer 20-year written material wear warranty that flooring is free from defects in workmanship and material.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flooring shall incorporate an EPA-licensed anti-microbial biocide to protect against algae growth, bacteria, fungi, mold, and mildew.
- B. Flooring shall be acceptable by USDA and applicable health authorities for use in food preparation areas.
- C. Slip Resistance: Floor shall provide a minimum wet DCOF AcuTest value of 0.42 in accordance with ANSI A137.1-2012.
- D. Physical Properties: System shall meet the following.
 - 1. Compressive Strength, ASTM C579: Not less than 8,000 psi.
 - 2. Tensile Strength, ASTM C307: Not less than 1,600 psi.
 - 3. Flexural Strength, ASTM C580: 4,300 psi.
 - 4. Surface Hardness, ASTM D2240: Durometer, Scale D, 81.
 - 5. Moh Hardness of Aggregates: 7 minimum.

2.2 MANUFACTURERS

- A. Resinous flooring shall be as provided by Crossfield Products Corp. as specified and the basis of design, or one of the following manufacturers, or equal with products in conformance with specification requirements, as approved by Architect.
 - 1. BASF Construction chemicals-Building systems
 - 2. Sherwin-Williams company; General Polymers Brand
 - 3. Tera-Lite, Inc.
 - 4. Stonhard

2.3 MATERIALS

- A. Resinous Flooring System: Trowel-applied seamless floor and cove base system of pre-engineered decorative aggregates embedded in a colored epoxy matrix; "Cheminert Terracolor" by Crossfield Products Corp. or equal.
 - 1. Thickness: 1/4 inch.
 - 2. Top Finish: Clear.
 - a. "Matte Finish Aerofloor Urethane" chemical resistant finish, followed by:
 - b. EPA-licensed "Dexcide" antimicrobial/antibacterial system.
 - 3. Colors of Matrix and Aggregates: To match "Cheminert Terracolor" color #413 "Speedway Gray."
- B. Antimicrobial/Antibacterial Additive: EPA-licensed, as recommended by flooring manufacturer.
- C. Vapor Control Primer: "Vapor Control Primer 200" with "SC Membrane" anti-fracture/vapor barrier compound, or equal.
- D. Cementitious Underlayment to Create Slope for Drainage (If Required): Polymer-modified, fast-setting, pre-packaged cementitious patching and leveling compound suitable for use over existing concrete; "A-81 Underlayment" or equal, with the following physical properties at 75 degrees F:
 - 1. Compressive Strength at 24 Hours, ASTM C109: 5,000 psi.
 - 2. Compressive Strength at 72 Hours, ASTM C109: 6,140 psi.
 - 3. Tensile Strength, ASTM C307: 800 psi.
 - 4. Flexural Strength, ASTM C580: 1,200 psi.
 - 5. Weight: 130 pounds per cubic foot.
 - 6. Adhesion, ASTM D4541: 400 psi minimum.
 - 7. Flammability: Non-combustible.

2.4 ADDITIONAL MATERIALS AND ACCESSORIES

- A. Metal Edge Protection: Extruded anodized aluminum; Schlüter Systems, or equal.
 - 1. Height, Width, and Profile: As shown on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that other Sections have completed penetrations of substrate before beginning installation.
- B. Examine substrate in order to verify that it is satisfactory. Substrate shall be:
 - 1. Free of excess moisture, as determined by testing.

2. Smooth and free of cracks, holes, ridges, coatings preventing adhesive bond.
- C. Flatness Tolerance of Substrate: 1/8-inch maximum depression between high spots when measured with a 10-foot straightedge.
- D. Testing of Prepared Concrete Subfloors: Test to verify that moisture, alkalinity, air moisture content, and bond of substrate are acceptable for installation of flooring. Moisture content and pH shall be tested as specified in Section 01 4520, "Concrete Moisture Testing.
- E. Determine moisture content and pH of concrete, and test concrete for adhesion. Perform tests in accordance with terrazzo manufacturer's instructions.

3.2 PREPARATION

- A. Comply with ASTM F710 and manufacturer's recommendations for surface preparation and for mixing and application of products.
- B. Clean and fill cracks, joints, and depressions with specified epoxy joint filler.
- C. Apply fabric-reinforced membrane to substrate as required to bridge cracks.
 1. Strip Size: As recommended by flooring manufacturer.
 2. Install with strips centered on crack.
 3. Crack width shall not exceed 1/8 inch.
 4. Where sides of crack are not in same plane, grind substrate until flush.
- D. Install vapor control primer in accordance with ANSI A108.13 and manufacturer's instructions. Turn up 4 inches at interface with walls and other vertical surfaces.
- E. Float slab with specified self-drying, self-leveling underlayment concrete if required for leveling or for slope to drain. Protect underlayment prior to installation of flooring, by use of plywood, hardboard, or other suitable protection course.

3.3 INSTALLATION

- A. General: Mix and apply each component of flooring system according to manufacturer's directions to produce a uniform monolithic flooring surface of thickness specified.
- B. Bond Coat: Apply t over prepared substrate at manufacturer's recommended spreading rate.
- C. Body Coat:
 1. Apply epoxy mortar mix over primer at nominal 1/4-inch thickness by hand or power trowel.
 2. Allow to cure before proceeding.
- D. Grout Coats:
 1. Apply two coats of grout.
 2. Sand and inspect the surface for consistency.
- E. Finish or Sealing Coats:
 1. After grout coats have cured sufficiently, apply finish coats to produce finish matching approved sample and in number of coats and spreading rates recommended by manufacturer.
 2. Final finish coat shall meet specified slip-resistance requirements.
- F. Finished floor shall be 1/4" thick, uniform in color and free of trowel marks.

G. Cove Base:

1. Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise shown.
2. Follow manufacturer's instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

3.4 PROTECTION

- A. Cover surface to protect from soiling, staining, marring, scratching, and other damage using protective products acceptable to flooring manufacturer.
- B. Keep traffic off of flooring until it has reached its final cure but not less than 24 hours.

END OF SECTION

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SECTION 09 8200

ACOUSTICAL INSULATION AND SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Batt acoustical insulation.
 - 2. Acoustical sealants and accessories.
 - 3. Sound isolation requirements.

- B. Related Requirements:
 - 1. Thermal Insulation: Section 07 2100; thermal batts
 - 2. Firestopping: Section 07 8400; mineral fiber firesafing; firestopping sealants.
 - 3. Joint Sealants: Section 07 9200; non-acoustical sealants.
 - 4. Plumbing: Division 22; plumbing pipe insulation.
 - 5. Heating, Ventilating, and Air Conditioning: Division 23; mechanical pipe and duct insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 3300, "Submittals."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications for each type of insulation, sealant, and manufactured sound isolation accessory to be used.

- B. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 QUALITY ASSURANCE

- A. Comply with Flame Spread Rating and Smoke Density requirements of CBC.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Clearly identify manufacturer, contents, brand name, and applicable standard.

- B. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

PART 2 - PRODUCTS

2.1 ACOUSTICAL BATTS

- A. Sound-Control Batt: Unfaced, friction fit, preformed slag mineral or glass fiber with thermosetting resin binders, conforming to ASTM C665, Type I; Owens-Corning "EcoTouch QuietZone PINK FIBERGLAS," or equal.
 - 1. Thicknesses: Full thickness, unless otherwise indicated.
 - 2. Surface Burning Characteristics: ASTM E84.
 - a. Smoke Developed: 50 or less.
 - b. Flame Spread: 25 or less.
 - 3. Combustibility: Pass ASTM E136.

2.2 ACOUSTICAL SEALANTS AND SOUND ISOLATION ACCESSORIES

- A. Acoustical Sealants:
 - 1. Non-Rated Conditions: USG "Sheetrock Acoustical Sealant," Tremco "Acoustical Sealant," SpecSeal "Smoke 'N' Sound", Henry's "Sound Control Sealant" No. 413, or equal conforming to ASTM C919 or equivalent.
 - 2. Fire-Rated Partition Perimeter Conditions: USG "Sheetrock Acoustical Sealant," Jaco "Fire and Draft Sealer," or equal.
 - 3. Acoustical intumescent caulk for fire rated penetrations: Hilti FS-One, 3M CP-25, or equal.
- B. Acoustical Tape: Low-density PVC foam; "Norseal" V-730 Series by Norton Performance Plastics Corp. or equal.
- C. Pipe Isolation Systems:
 - 1. General:
 - a. Coordinate with Divisions 22, "Plumbing," and 23, "HVAC."
 - b. Do not use pipe isolation systems which utilize a felt insert.
 - 2. Pipes One Inch or Smaller in Diameter: As follows, or equal.
 - a. "Acousto-Plumb."
 - b. "Holdrite Silencer" Model #261 (1/2 inch diameter), Model #262 (3/4 inch diameter), Model #263 (1 inch diameter).
 - 3. Pipes Larger than One Inch in Diameter, and for Hanger Liners: As follows, or equal.
 - a. Sections of closed cell neoprene sleeves such as AP/Armaflex.
 - b. "Holdrite Silencer" Model #264 (1-1/4 inch diameter), Model #270 (2 inches wide), Model #271 (2 inches wide).
- D. Electrical Box Treatment:
 - 1. Outlet Box Pads: Polybutene-butyl with inert fillers, minimum 1/8-inch thick; Lowry's "Outlet Box Pads," Sound Pad #68 by LH Dottie Co., 323-725-1000, or equal.
 - 2. Sealant: Lowry's "Electrical Box Sealer," or equal.
 - 3. See Section 07 8400, "Firestopping," for pads and sealant at fire-rated assemblies.
- E. Sealant Backer Rod: Compressible, rod-stock, polyethylene foam; nongassing, polyethylene-jacketed polyurethane foam; butyl-rubber foam; neoprene foam; or other flexible, permanent, durable, nonabsorptive, closed-cell material as recommended for compatibility with sealant by sealant manufacturer.
- F. Miscellaneous Fastenings and Accessories: As acceptable to insulation manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas scheduled to receive insulation so as to ensure protection against inclement weather and other hazards and to verify that work of preceding trades is completed.
- B. Examine space allocated for insulation for proper depth to receive material.

3.2 INSTALLATION OF ACOUSTICAL INSULATION

- A. Install to fill completely all typical and odd spaces in framing where required.
- B. Install snugly between framing members. Fit ends snugly between units and against adjacent construction.
- C. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.
- D. At doorframes, cut additional strips of insulation, and hand-pack as necessary to fill voids thoroughly.
- E. Install glass fiber batt insulation, R-11 minimum, in otherwise uninsulated wall or ceiling cavities containing plumbing pipes.

3.3 SOUND ISOLATION

- A. Sound-insulate all interior partitions adjacent to occupied spaces, including toilet rooms.
- B. Seal sound-insulated partitions airtight with acoustical sealant, in accordance with ASTM C919 and manufacturer's recommendations.
- C. Intersections: Hold gypsum board back a maximum of 1/4 inch from intersecting gypsum board with floor or other surfaces, and apply a bead of acoustical sealant. Caulk void full and airtight with acoustical sealant.
- D. Penetrations: Penetrations by conduits, ducts, and pipes shall be sealed airtight.
 - 1. Holes smaller than 1 inch but too large to seal with sealant shall first be packed with mineral fiber and then sealed airtight.
 - 2. Holes larger than 1 inch shall first be packed with glass or mineral fiber, then sealed over with acoustical putty pads, and then sealed airtight.
- E. Utility Boxes: Back and sides of all electrical, telephone and CATV boxes in sound-insulated walls shall be sealed airtight with specified pads.
 - 1. Verify that all unused knockouts are plugged before installing the pads.
 - 2. Mold pads tightly to the boxes and to the adjacent surfaces.
- F. Install pipe isolation system wherever a pipe penetrates a stud or framing member.
- G. Where sound-insulated walls are fire rated, follow requirements of Section 07 8400, "Firestopping."
- H. Prior to closing walls, obtain observation of insulation installation by District's Representative.

3.4 PROTECTION

- A. Protect installed insulation from physical abuse. Coordinate with Section 09 2900, "Gypsum Board," for prompt installation of gypsum board.

END OF SECTION

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SECTION 09 8319
ACOUSTIC WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fabric wrapped acoustical wall panels and installation components.
- B. Related Sections:
 - 1. Section 09 2900 – Gypsum Board
 - 2. Section 09 9000 – Painting and Coatings

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Contract Closeout," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Submit shop drawings showing how panels are to be laid out on the walls, details of trim members and width of panels. Width of panels and location of vertical seams are critical.
- B. Product Data: Manufacturer's recommended installation details, installation procedures, and maintenance procedures.
- C. Samples:
 - 1. 8"x11" samples of specified acoustical wall substrate with factory detailed edge and representative samples of mounting devices and attachment method including trim and decorative accents;
 - 2. 8 inch x 10 inch square of specified fabric in selected color.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.

1.4 CLOSEOUT SUBMITTALS

- A. Specified warranties.
- B. Manufacturer's cleaning and maintenance instructions.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and installation components by a single manufacturer.

- B. Manufacturer & Installer: Firm manufacturing the specified product shall have adequate capacity required for projects listed and have successfully completed similar projects for a period of not less than five years. The installer shall be approved by the manufacturer as qualified to perform work required.
- C. Reference Standards: Conform to all governing laws, building codes, and the following performance criteria:
 - 1. Fire Performance Characteristics: Identify acoustical wall components with appropriate markings of applicable testing and inspecting organization.
 - a. Surface Burning Characteristics tested per ASTM E 84,
 - b. Flame Spread: 25 or less
 - c. Smoke Developed: 200 or less
 - 2. Acoustical Performance Characteristics: Provide acoustic wall panels with acoustical absorption characteristics as indicated in Part 2, which have been determined by testing fully assembled production material in accordance with ASTM C-423 (Type "F5" mounting as defined by ASTM E-795) by a testing organization acceptable to authorities having jurisdiction. Approved testing organization must be independent of the manufacturer.
 - 3. All fabric finishes specified for acoustic panels shall be tested in accordance with ASTM D6207 - *Standard Test Method for Dimensional Stability of Fabrics to Changes in Humidity and Temperature*
- D. Coordination of Work: Coordinate acoustical wall work with installers of related work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical wall panels to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical wall panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical wall panels carefully to avoid chipping edges or damaged units in any way

1.7 FIELD CONDITIONS

- A. Ambient Conditions: Maintain ambient and substrate temperature and moisture content as recommended by manufacturer.

1.8 WARRANTY

- A. Acoustical Wall Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Acoustical Wall Panels: Manufacturer's defects
- B. Warranty Period:
 - 1. Acoustical wall panels: One (1) year from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Wall Panels: Furnish quantity of full-size units equal to 5.0 percent of amount installed, but at least one panel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Acoustical Panels:
 - 1. Fabric finished panels shall be type AP with resin hardened edges by Decoustics Limited, TEL: (800)387-3809; www.decoustics.com. or approved equal.
- B. Acceptable Products:
 - 1. Soundsoak 85, FR-701 by Armstrong World Industries.
 - 2. Respond A as manufactured by Conwed: <https://www.conwed.com/>
 - 3. Substitutions: See Section 01 6200 - Product Options and Substitutions.
 - 4. Provide all acoustical panels by one manufacturer.

2.2 MATERIALS

- A. Panels: Prefinished, factory assembled fabric-covered panels.
- B. Panel Sizes: as indicated on drawings.
- C. Core:
 - 1. Density: 6-7 lb/cu ft.
 - 2. Acoustically Absorptive.
 - 3. Resin hardened edge.
 - 4. Noise Reduction Coefficient (NRC): 0.85 minimum
 - 5. Panel Thickness: 1 in.
 - 6. Edges: Perimeter edges reinforced by an aluminum frame, a galvanized steel frame, or a formulated resin hardener.
 - 7. Corners: As detailed.
 - 8. Mounting: Back-mounted, mechanically fastened.
 - 9. Flame Spread: Class A, less than 25 in accordance with ASTM E84.
- D. Fabric Covering: Seamless fabric facing material, for stretched covering of core material.
 - 1. Fabric: Xorel by Carnegie Fabric
 - 2. Color: Per Architect, unbacked.
 - 3. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

- A. Measure each wall area and establish layout of acoustical units to balance border widths at opposite edges of each wall. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. Prior to panel installation, the site must be free of all wet and dusty trades and the climatic conditions stabilized to normal operational levels. Panels shall be allowed to stabilize on site 24 hours prior to installation.
- B. Panels must only be handled by persons wearing clean light-weight gloves. It is very important that personnel installing hardware (wall clips, screws, anchors, etc.) do not handle the panels before putting the clean lightweight gloves on
- C. Install wall panels by attaching the panels per the manufacturer's instructions.

3.4 PROTECTION

- A. Replace damaged and broken panels.
- B. Routine maintenance of wall panels should consist of frequent vacuuming to minimize dirt accumulation. A dry or wet shampoo can be used on fabric. Work in with a damp sponge and vacuum to remove residue.

END OF SECTION

SECTION 09 9000

PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Painting and painter's finish on all exposed exterior and interior surfaces, except prefinished items and unless otherwise noted, as required to complete finishing of the Work. The Work includes the following specific items:
1. Visible interior of ductwork.
 2. Electrical Subpanels: Paint to match adjacent wall surface.
 3. Mechanical and plumbing vents on roof.
 4. Exposed metal flashing at exterior not indicated or specified to be prefinished.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 2. Closeout Submittals shall be submitted in accordance with Section 01 7700, "Closeout Procedures."
- B. Coordination: Perform painting work in proper sequence with work of other trades so as to avoid damage to finished work.

1.3 ACTION SUBMITTALS

- A. Schedule: Proposed manufacturer's products grouped by System using same System identification included in these Specifications.
- B. Product Data: Manufacturer's technical information for each product scheduled including paint label analysis and application instructions.
- C. Color Samples:
1. Appropriately label and identify each sample, including location and application. Include color identifier used by District's Representative, manufacturer's name, color number, and gloss units.
 2. Gypsum Board: Prepare on gypsum board with specified level of finish, 18 inches square.
 3. Wood: Prepare on type and quality of wood specified, 12 inches square or long, as applicable.
 4. Other Surfaces: Prepare on hardboard, 8 inches square.
 5. Each sample shall have stepped finish, clearly showing each coat and build-up of specified finish. Submit separate samples for each required gloss level.
 6. Resubmit samples as requested until required sheen, color, and texture are achieved.
 7. See also requirements for field samples below.
- D. LEED Submittals:
1. Product Data for Credit EQ 4.2: For field applied, interior, paints coatings and primers, include printed statement of VOC content indicating compliance with Credit requirements.
 - a. Include LEED Product Information Form for LEED Credit EQ 4.2.
 2. Provide additional documentation for products as required to achieve each Credit(s)

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of applicator qualifications.

1.5 MAINTENANCE SUBMITTALS

- A. At completion of the Work, deliver to District extra stock of paint of each color used in each coating material used.
- B. Containers shall be full, tightly sealed, and clearly marked.
- C. Provide the following quantities:
 - 1. Field Colors: 1 five-gallon container.
 - 2. Accent Colors: 1 gallon container.

1.6 CLOSEOUT SUBMITTALS

- A. Listing of each coating used including manufacturer name, paint type, color name, and color formula.

1.7 QUALITY ASSURANCE

- A. Single-Source Responsibility:
 - 1. To the maximum extent practicable, select a single manufacturer to provide all materials required by this Section, using additional manufacturers to provide systems not offered by the selected principal manufacturer.
 - 2. For each individual system:
 - a. Provide primer and other undercoat paint produced by same manufacturer as finish coat.
 - b. Use thinner within manufacturer's recommended limits.
- B. Applicator Qualifications:
 - 1. Not less than 5 years of documented experience in painting work similar in scope to work of this Project.
 - 2. Maintain a crew of painters who are fully qualified to satisfy requirements of this Section.
- C. Field Samples:
 - 1. Request review, by the District's Representative, of first finished area, room, space, or item of each finish type or color scheme required for color, texture, and workmanship.
 - 2. Modify selected colors, if requested by District's Representative, to achieve desired effect.
 - 3. Use accepted surface as the Project standard for each color scheme and gloss level.
- D. Primers:
 - 1. Provide finish coats that are compatible with prime paints used.
 - 2. Review other Sections of these Specifications in which prime paints are to be provided in order to ensure compatibility of total coatings system for various substrates.
 - 3. Upon request, furnish information to other Sections regarding characteristics of finish materials proposed for use.
 - 4. Provide barrier coats over incompatible primers or existing coatings, or remove and re-prime as required.
 - 5. Notify District's Representative, in writing, of any anticipated problems arising from using specified coating systems with substrates primed by other Sections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original, new, unopened packages and containers bearing the manufacturer's name and label and the following information:
 - 1. Name or title of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume for major pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
- B. Store materials in tightly covered containers. Maintain containers in a clean condition, free of foreign materials and residue.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.9 FIELD CONDITIONS

- A. Ambient Conditions:
 - 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
 - 2. Do not apply finish in areas where dust is being generated.
 - 3. Provide adequate lighting.
 - 4. Provide lighting level of at least 80 foot-candles, measured mid-height at substrate surface.
- B. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.

1.10 GUARANTEE

- A. Contractor: The following shall be included under the guarantee provided to District under this Contract:
 - 1. At the end of 1 year, colors of surfaces shall have remained free from serious fading. Variations (if any) shall be uniform.
 - 2. Materials shall have their original adherence at end of 1 year. There shall be no evidence of blisters, running, peeling, scaling, chalking, streaks, or stains at end of this period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Campus Standard: Kelly-Moore Paint Company, the District Standard. Substitutions not allowed.

2.2 MATERIALS

- A. Paint Products: As specified under "Paint Systems" in Part 3 below with listed products by Kelly-Moore Paint Company, except as otherwise noted.
- B. Cementitious Filler: Nonshrink formulations of white Portland cement with fine silicate aggregate, zinc oxide pigment, and reinforcing chemical binder, as accepted.
- C. Spackling Compound: Standard gypsum board compound.

- D. Thinner: As recommended by each manufacturer for the respective product.

2.3 COLORS

- A. District's Representative will prepare a color schedule with samples for guidance of painter and reserves right to select, allocate, and vary colors on different surfaces throughout building. Colors selected by District's Representative may be from manufacturer's standard palette or be custom mixed.
- B. Submit samples of selected colors as specified in Part 1.
- C. Areas or surfaces indicated as black, either on the Drawings or specified, shall be so painted unless specifically directed otherwise.

2.4 MIXING AND TINTING

- A. Deliver paints and stains ready mixed to jobsite.
- B. Accomplish job mixing and job tinting only if required for adjustment to finish applied to field test areas to achieve color acceptable to District's Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and that cannot be put into acceptable condition through preparatory work as included in Article 3.2, "Preparation."
- B. Do not proceed with surface preparation or coating application until conditions are suitable.

3.2 PREPARATION

- A. General:
 - 1. Broom-clean rooms and spaces before commencement of the work.
 - 2. Verify that surfaces to be painted are dry, clean, smooth, and free from deleterious materials.
 - 3. Protect hardware, nameplates, switch plates, lighting fixtures, stainless steel, aluminum, and other surfaces that are not to be painted by masking, removal, or by other means to ensure a neat job.
 - 4. Locate and install scaffolding and staging so as not to interfere with the work specified in other Sections.
- B. Wood - General:
 - 1. Cleaning and Sanding:
 - a. Remove handling marks and effects of exposure to moisture with a thorough, final sanding over all exposed surfaces, using 150-grit or finer sandpaper.
 - b. Clean and vacuum before applying sealer or finish.
 - 2. Fill nail holes, cracks, open joints, and other defects with filler after priming coat has dried. Color shall match finish color.
- C. Gypsum board shall be prepared and finished for painting as specified in Section 09 2900, "Gypsum Board."

- D. Metals:
 - 1. Remove mill scale, rust, and corrosion.
 - 2. Clean oils, grease, and dust from surfaces.
 - 3. Touch up chipped or abraded areas in shop coatings, using appropriate primer.
 - 4. Soluble Salts: Removal of soluble salts from bare metal and galvanized metal surfaces, both interior and exterior, is required prior to application of primer coats to preclude premature coating failure and accelerated corrosion.
 - a. Removal shall be in accordance with SSPC-Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates."
 - b. Abrasive blasting, where specified as a required surface preparation procedure, shall be performed after removal of soluble salts. Abrasive blasting is not an acceptable procedure for removal of soluble salts.
- E. Ductwork: Clean visible galvanized portion of ductwork interiors with solvent, and wipe clean.
- F. Surfaces that cannot be prepared or painted as specified shall be immediately brought to the attention of the District's Representative, in writing.
 - 1. Starting of work without such notification will be considered acceptance by the Contractor of surfaces involved.
 - 2. Replace unsatisfactory work caused by improper or defective surfaces, as directed by District's Representative.

3.3 FACTORY FINISHING AND PRIMING

- A. Review all Sections for products that are to be factory finished or factory (shop) primed.
- B. Touch-up: Touch up abrasions in prime coat for products after arriving on jobsite and prior to application of finish coats.

3.4 APPLICATION

- A. Shop-fabricated and finished metal and millwork items shall be shop spray finished to the greatest extent possible.
- B. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.
- C. Application:
 - 1. Apply paint with suitable brushes, rollers, or spraying equipment.
 - 2. Railings, guardrails, steel doorframes, and other exposed metal requiring field finish painting shall be sprayed to the fullest extent conditions will permit. If brush or roller application is used, surface finish shall be subject to review by the District's Representative for complying with the appearance requirements specified herein.
 - 3. Apply coatings in accordance with manufacturer's recommendations.
 - 4. Rate of application shall be within limits recommended by paint manufacturer for surface involved.
- D. Spray-Gun Application - Standard Coatings:
 - 1. Spray-apply standard paints only with airless sprayer.
 - 2. Apply in fine, even spray, without addition of thinner, using nozzle pattern suitable to surface being painted.
 - 3. When necessary, follow by brushing to ensure uniform coverage and to eliminate wrinkling, blistering, and air holes.
 - 4. If spraying becomes detrimental to equipment or objectionable to personnel, brush painting will be required.

- E. Comply with recommendation of product manufacturer for drying time between succeeding coats.
- F. Finish coats shall be smooth and free from brush marks, streaks, laps or pileup of paints, and skipped or missed areas.
- G. Leave all parts of moldings and trim clean and true to details with no undue amount of paint in corners and depressions.
- H. Make edges of paint adjoining other materials or colors clean and sharp, with no overlapping.
- I. Refinish whole area where portion of finish is not acceptable.
- J. Equipment adjacent to walls shall be disconnected, using workers skilled in appropriate trades, and moved to permit wall surfaces to be painted. Following completion of painting, they shall be expertly replaced and reconnected.
- K. Top and bottom edges of all doors shall receive same paint system finish required for door faces.
- L. Paint visible surfaces behind vents, registers, or grilles flat black.
 - 1. Prepare exposed metal as specified, then prime and paint as scheduled.
 - 2. Spray-paint wherever practicable.
- M. Do not paint over fire-rating labels, fusible links, or sprinkler heads.
- N. Exposed Plumbing and Mechanical Items: Items without factory finish such as conduits, pipes, access panels, and items of similar nature shall be finished to match adjacent wall and ceiling surfaces, unless otherwise directed.

3.5 CLEANING

- A. Touch up and restore finish where damaged.
- B. Remove spilled, splashed, or spattered paint from surfaces.

3.6 PAINT SYSTEMS

- A. General:
 - 1. Only major areas are scheduled, but miscellaneous and similar items and areas within room or space shall be treated with suitable system.
 - 2. This Specification shall serve as guide and is meant to establish procedure and quality. Confer with the District's Representative to determine exact finish desired.
 - 3. Number of coats scheduled is minimum. Additional coats shall be applied at no additional cost as required to hide base material completely, produce uniform color, and provide required and satisfactory finish.
- B. Surfaces Not to Be Painted:
 - 1. Prefinished wall, ceiling, and floor coverings.
 - 2. Items with factory-applied final finish.
 - 3. Concealed ducts, pipes, and conduit.
 - 4. Surfaces specifically scheduled or noted on the Drawings as not to be painted.
- C. Acceptance of Final Colors: Final coat of paint for both exterior and interior shall not be applied until colors have been accepted by the District's Representative.

- D. Gloss and Sheen Ratings: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following limits in conformance with Master Painters Institute, Inc. (MPI) Standards according to ASTM D523. Not all of the Gloss Levels are necessarily scheduled or used on this Project.
1. Gloss Level 1: Matte or Flat; not more than 5 units at 60 degrees and 10 units at 85 degrees.
 2. Gloss Level 2: Velvet or Low Sheen; not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 3. Gloss Level 3: Eggshell; 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 4. Gloss Level 4: Satin; 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 5. Gloss Level 5: Semi-gloss; 35 to 70 units at 60 degrees.
 6. Gloss Level 6: Gloss; 70 to 85 units at 60 degrees.

- E. Clarification of System Terminology:
1. Interior paint Systems are specified and identified herein by initial letters "INT."
 2. Exterior paint Systems are specified and identified herein by initial letters "EXT."
 3. Initial numbers for each System identify the substrate to be coated summarized as follows with further clarification included with the System description:

CODE	DESCRIPTION
5	Metal
6	Wood
9	Gypsum Board

4. Letter following substrate numbers identify the general finish coat chemistry summarized as follows:

CODE	DESCRIPTION
A	Standard acrylic
B	Premium vinyl acrylic
H	High performance aliphatic polyurethane
M	High dispersion acrylic polymer

5. Hyphenated suffix identifies the topcoat gloss levels.

F. Interior Painting Systems:

INT 5.2A-5
Acrylic on Shop Primed Metal Including Hollow Metal Doors and Frames - Gloss Level 5

2 coats	1050 Premium Professional	Latex Semi-Gloss
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Note: Modify scheduled finish coat if higher or lower gloss level is selected by District's Representative.

INT 5.2M-5
Premium Performance Acrylic on Exposed Metal - Gloss Level 5

1 coat	5725 DTM	Acrylic Primer
2 coats	5585 DTM	100% Acrylic Semi-Gloss

INT 5.2M-6
Premium Performance Acrylic on Exposed Metal - Gloss Level 6

1 coat	Devacryl 1440	Waterborne Acrylic
2 coats	Devacryl 1449	100% Acrylic Gloss

INT 6.3A-5
Acrylic on Millwork and Wood Doors - Gloss Level 5

1 coat	973 AcryPlex	Acrylic Primer (if not shop primed)
2 coats	1050 Premium Professional	Latex Semi-Gloss

INT 6.4I-5
 Intumescent on Plywood Utility Backboards - Gloss Level 3
 1 coat Benjamin Moore Insl-x™FR-110 Fire Retardant Paint

INT 9.2A-1
 Acrylic on Gypsum Board - Gloss Level 1
 1 coat 971 AcryPlex PVA Primer/Sealer
 2 coats 1005 Premium Professional Latex Flat

INT 9.2A-3
 Acrylic on Gypsum Board - Gloss Level 3
 1 coat 971 AcryPlex PVA Primer/Sealer
 2 coats 1010 Premium Professional Latex Eggshell

INT 9.2A-5
 Acrylic on Gypsum Board - Gloss Level 5
 1 coat 971 AcryPlex PVA Primer/Sealer
 2 coats 1650 Premium Professional Latex Semi-Gloss

INT 9.2F-5
 Epoxy-Like Acrylic on Gypsum Board - Gloss Level 6
 1 coat 971 AcryPlex PVA Primer/Sealer
 2 coats 1680 DuraPoxy 100% Acrylic Gloss

G. Exterior Painting Systems

EXT 3.1A-1
 Acrylic on Concrete - Gloss Level 1
 1 coats 247 AcryShield Acrylic Masonry Primer
 2 coats 1200 Premium Professional 100% Acrylic Flat

EXT 3.1A-1
 Acrylic on Concrete - Gloss Level 2
 1 coats 247 AcryShield Acrylic Masonry Primer
 2 coats 1210 Premium Professional 100% Acrylic Low Sheen

EXT 3.2A-1
 Acrylic on Cement Plaster - Gloss Level 1
 2 coats 1200 Premium Professional 100% Acrylic Flat

Note: Modify gloss level of finish coat if selected by Architect.

EXT 4.1A-3
 Acrylic on Concrete Unit Masonry - Gloss Level 1
 1 coat 247 AcryShield Acrylic Masonry Primer
 2 coats 1200 Premium Professional 100% Acrylic Flat

EXT 4.1A-3
 Acrylic on Concrete Unit Masonry - Gloss Level 2
 1 coat 247 AcryShield Acrylic Masonry Primer
 2 coats 1210 Premium Professional 100% Acrylic Low Sheen

EXT 5.2A-5
 Acrylic over Shop Primed Metal Doors and Frames, Steel Frame, Mechanical and Electrical
 Equipment, and Panels - Gloss Level 5
 2 coats 1215 Premium Professional 100% Acrylic Semi-Gloss

EXT 5.2H-5

High Performance Urethane over Epoxy on Shop Primed Steel – Gloss Level 5

1 coat	Devoe Bar-Rust 235V	Two-component, epoxy tinted to match color of topcoat
1 coat	Devoe Devthane 378H	Two-component aliphatic urethane

Note: Provide additional topcoat if required to achieve manufacturer’s recommended total DFT (primer plus finish coats), or to achieve complete hiding for selected color.

EXT 5.3A-6

Premium Acrylic over Waterborne Primer on Galvanized Metal – Gloss Level 5

Pretreatment	SSPC SP-1	Heavy-duty cleaner
1 coat	5725 DTM	Acrylic Primer
2 coats	1250 AcryShield™	100% Acrylic Semi-Gloss

Note: Provide pretreatment and primer if preparation and primer not applied in shop

EXT 5.3H-5

High-Performance Urethane over Epoxy on Galvanized Steel – Gloss Level 5

Pretreatment	SSPC SP-1	Heavy-duty cleaner
1 coat	Tru-Glaze-WB 4030	Two-component waterborne epoxy tinted to match color of topcoat
1 coat	Devthane 378H	Two-component aliphatic urethane

Note: Provide additional topcoat if required to achieve manufacturer’s recommended total DFT (primer plus finish coats), or to achieve complete hiding for selected color.

3.7 MISCELLANEOUS PAINTING

- A. Mechanical and Electrical Equipment, Conduits and Piping: Paint exposed items as scheduled using appropriate system for material and whether or not item has been factory-primed.
- B. Exposed Insulation-Covered Piping: Size with “Arabol” or equal latex type adhesive and apply 2 coats of semi-gloss acrylic.
- C. Material Visible through Grilles, Screens, Louvers, Vents and Screens and Exposed Hardware Cloth Screening: Painted flat black to make as unnoticeable as possible.
- D. Mechanical Equipment: Paint mechanical equipment housings where indicated on the Drawings.

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SECTION 10 1100

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall-mounted liquid marker type whiteboards.
 - 2. Tack boards.
 - 3. Hardware and accessories for complete installation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout Procedures.", and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Provide dimensioned elevations showing layout and configuration of board.
 - 2. Show sections of trim members; key to elevations.
 - 3. Show anchors, grounds, reinforcement, and accessories.
- B. Product Data: Manufacturer's technical data for boards and accessories.
- C. Samples:
 - 1. Boards: 5 by 8 inches, full thickness, illustrating each color and finish.
 - 2. Trim and Accessory: Each profile, minimum 8 inches long.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's certification that materials furnished comply with specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturer's installation and breaking-in instructions, and cleaning and maintenance instructions covering both routine (daily or weekly) and long-term (yearly or longer) operations.
- B. Extended warranty.

1.6 FIELD CONDITIONS

- A. Environmental Requirements: Install boards only when interior air and substrates have reached equilibrium moisture and temperature approximating that of normal occupied conditions.

- B. Take field measurements prior to shop fabrication where necessary in order to ensure proper fitting of work.

1.7 DELIVERY AND STORAGE

- A. Wrap or otherwise package boards and components for protection against damage during shipment and storage.
- B. Store porcelain enameled steel panels on edge in a manner to prevent bowing, warping, or other irregularities.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 WARRANTY

- A. Manufacturer: Furnish District with manufacturer's written warranty agreeing to replace boards that do not retain their original writing and erasing qualities, that become slick and shiny, or that exhibit crazing, cracking, or flaking, provided manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.
 - 1. Replacement may be limited to material replacement only.
 - 2. Labor for removal and reinstallation may be excluded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Polyvision: <https://polyvision.com/>
 - 2. Claridge Products & Equipment: <https://claridgeproducts.com/>
 - 3. AARCO Products, Inc.: <http://www.aarcoproducts.com/>

2.2 MARKER BOARDS

- A. White Marker Boards: Magnetic porcelain writing surface manufactured specifically for use with liquid marker systems; "e3CeramicSteel" by PolyVision, "LCS3 Markerboards" by Claridge, or equal.
 - 1. Color: Low Gloss White.
 - 2. Layout and Sizes: As shown.
 - 3. Frame: with concealed fasteners.
- B. Multiple Units: Where multiple units are required and length of marker board exceeds maximum available from manufacturer, provide concealed splice joints at locations as approved by District's Representative.

2.3 TACK BOARDS

- A. Vinyl Fabric Tack Boards: Vinyl-coated fabric laminated to molded, recycled post-consumer paper, cellulose fiber structural panel by Chatfield-Clarke Co., Inc., 909- 823-4297, or equal.
 - 1. Backing Panel: Nominal 16 pound per cubic foot density, flame resistant, industrial insulation board.
 - a. Thickness: 1/2 inch.
 - b. Compressive Strength: 30.0 psi.
 - c. Flammability: ASTM E84, Class A.
 - 1) Flame Spread: 15.

- 2) Smoke Developed: 50
2. Vinyl Fabric: Complying with NSF/ANSI 342 and the following.
 - a. Total Weight: Not less than 15 ounces per square yard.
 - b. Backing: Osnaburg or Drill as standard with manufacturer.
 - c. Width: 54 inches wide.
 - d. Color and Texture:
 - 1) Pattern: To be selected from Koroseal School Collection.
 - 2) Color: To be selected by Architect from manufacturer's standards with total number selected not to exceed 4.
 - e. Fabric shall wrap around edges and overlap back of panel.

2.4 ACCESSORIES

- A. Aluminum Trim: Slip-on type; 6063-T5 alloy extrusions of at least 0.062 inch wall thickness.
 1. Finish: Clear anodized, AA designation M12C22A31.
 2. Provide trim in single lengths wherever possible, otherwise keep joints to a minimum.
- B. Tack Board Joint Covers: As shown, factory covered in vinyl to match tack board fabric.
- C. Marker Trough: Manufacturer's standard ribbed section, solid extrusion with exposed ends smoothly curved. Provide trough under all boards.
- D. Attachment Hardware: Manufacturer's standard fully concealed attachment system for securing units to wall surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are true and plumb, and that backing is in place. Correct inadequate substrates before installation of boards.
- B. Verify that moisture and temperature levels of substrate and environment have stabilized.

3.2 INSTALLATION

- A. Install boards in location and at mounting heights shown and in accordance with manufacturer's instructions.
 1. Keep perimeter lines straight, plumb, and level.
 2. Join parts with a neat, precise fit.
 3. Joints are not permitted in boards less than 12 feet long.
- B. Aluminum Trim: Provide as specified and as shown.

3.3 PROTECTION

- A. Cover completed work with plastic sheet or other covering recommended by manufacturer.
- B. Protect boards from damage until acceptance by Owner.

END OF SECTION

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SECTION 10 1400

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Code required signage.
 - 2. Exterior building identification and other non-code signage.
- B. Related Requirements:
 - 1. Signage requirements included on the Drawings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout" and Section 01 7800 "Project Records Documents."
- B. Coordination:
 - 1. Prior to production of shop drawings and samples, coordinate a pre-submittal conference with District's Representative to confirm submittal requirements, schedule, and sign review process.
 - 2. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs. Provide template for placement of sign-anchorage devices and electrical service embedded in permanent construction by other installers.

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Full-scale drawings and signage schedule for each sign indicating materials, lettering layout, and colors.
 - a. Digital artwork files prepared by the District's Representative for the Contractor's use shall be a single layer. Manipulations of the files required for subsequent use by the Contractor, such as spreads, and traps for silkscreen negatives, building plans for Emergency Evacuation Maps, or conversion to outline or EPS, shall be the responsibility of the Contractor unless explicitly agreed otherwise by the District's Representative.
 - 2. Large-scale drawing and details of custom logo and lettering. Include mounting details.
 - a. Include plans, elevations, and large-scale sections of typical members and other components.
 - b. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
 - 3. Font Style. 18 point graphical example of alphabet and numerical numbers 0 through 9 of signage font style, upper and lower case letters, punctuation, 18 point scale, and black text on white paper.

- B. Product Data: Furnish material literature and indicate each sign type, material, style, color, and method of attachment.
- C. Samples:
 - 1. Unless otherwise noted in construction document signage details, submit three proposed samples of signage fonts to be used for visual and tactile characters. Signage fonts shall comply with 2016 California Building Code Title 24 11B-703.2 tactile Raised Characters and 11B-703.5 Visual Characters.
 - 2. Color Verification and Size: Not less than 6-inches square, and when applicable, include color system name and serial number, code and name as applicable.
 - 3. Control Samples. Samples shall be prepared on same base material to be used in fabrication. Submit one sample of each sign type. Signage types are indicated in Construction Document details. Interior signs shall be full size.
 - 4. Dimensional Letters: One full-size representative samples of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.
 - 5. Symbol of Accessibility Pictograms. Full scale sample of pictograms to be used on sign panels and graphics. Pictograms shall comply with 11B- 703.7 unless otherwise noted on the Construction Drawings.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Signage Schedule and Alphanumeric Nomenclature. As a component of shop drawings and informational submittals, verify with District's Representative the sign nomenclature; room names and numbers; wording of way-finding, directional and informational signage; English and multi-lingual text; and, orientation of wayfinding pictorial graphics.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data for signs and sign types including maintenance manuals.
- B. Extended guarantee as specified.

1.6 QUALITY ASSURANCE

- A. Contractor shall assure that the vendor shall be responsible for the quality of materials and workmanship of any firm acting as the vendor's subcontractor.
- B. Furnish products of a single manufacturer for each sign type and graphic image processes indicated.
- C. Mockups:
 - 1. Prior to installation, install pre-installation paper mockup signs for review at locations designated by District's Representative. The job-site review is to confirm compliance with the information included on the Drawings, typical installation conditions, and determine installation locations for non-typical conditions.
 - 2. Prior to installation, provide a taping pattern for sign plaques, and pin-mounting or stud patterns for individual letter signs components.
 - 3. Comply with additional requirements of Section 01 4339, "Mockups."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver signs safely packed to prevent damage during shipment. Package separately or in like groups of names, labeled as to names enclosed; include installation template, attachment system and installation instructions.
- B. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

1.8 FIELD CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions

1.9 GUARANTEE

- A. Contractor: Furnish District with a written extended 5-year guarantee for signage against all defects in materials and workmanship, including without limitation against yellowing, cracking, crazing, and other visible and performance defects.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Regulatory Standards: Except as otherwise specified or shown, signage shall conform to the following:
 - 1. ANSI A-117.1 and the Americans with Disabilities Act (ADA).
 - 2. ATBCB Design Guidelines for Signage in relation to the Americans with Disabilities Act.
 - 3. California Code of Regulations, Titles 19 and 24.
 - a. California Grade 2 Braille shall be used whenever Braille symbols are specifically required. Refer to CBC Section 11B-703.3.
 - b. All signage shall conform to CBC Section 11B-703.
 - 4. Uniform Sign Code.
- B. Design Criteria:
 - 1. Visual Characters: Section 11B-703.5.
 - a. Character Spacing: Section 11B-703.5.8.
 - 1) 10 percent minimum and 20 percent maximum of height of characters, measured between two closest points of adjacent characters, excluding word spaces.
 - b. Line Spacing: Section 11B-703.5.9.
 - 1) Spacing between baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of character height.
 - 2. Raised Characters: Section 11B-703.2.
 - a. Letter Type: Section 11B-703.2.1.
 - 1) Raise characters on signs 1/32 inch minimum.
 - 2) Characters shall be sans serif uppercase characters accompanied by Grade 2 Braille.
 - b. Character Size: Section 11B-703.2.5.
 - 1) Raised characters shall be a minimum of 5/8 inch and a maximum of 2 inches high.
 - c. Proportions of Letters and Numbers: Section 11B703.2.4.
 - 1) Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 (60 percent to 110 percent) and a stroke width-to-height ratio of 15 percent.
 - d. Letters measured to verify compliance must be uppercase.

- 1) After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch high.
 - 2) Place the template's 1:1.1 (110 percent) square over the O, whichever is narrower. If the character is not wider than 1 inch, nor narrower than the 3:5 (60 percent) rectangle, the proportions are correct.
 - 3) Use the 1:5 rectangle to determine if the stroke of the I is too broad, or too narrow.
 - 4) If the tests are passed, the typestyle is compliant with proportion code.
3. Braille Symbols: Section 11B-703.3.
 - a. California Contracted Grade 2 Braille with rounded or domed dots shall be used wherever Braille is required. Dots with straight sides and flat tops are not readable for many Braille users and are not acceptable.
 - b. Space dots 1/10 inch on center in each cell with 2/10 inch space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Refer to Table and Figure in CBC 11B-703.3.1.
 - c. Raise dots a minimum of 1/40 inch above the background.
 - d. Installation Height: 11B-703.4.
 4. Pictograms: Section 11B-703.6.
 - a. Field: 6" high. Characters and Braille shall not be located in the pictogram field, 11B-703.6.1.
 - b. Text Descriptors: Locate text descriptors directly below the pictogram field.
 5. International Symbol of Accessibility: Section 11B-703.7.2.1 and figure 11B- 703.7.2.1.
 6. Contrast and Finish of Symbols: Section 11B-703.6.2.
 - a. Contrast between character, symbols and their background must be 70 percent minimum and have a non-glare finish.
 7. Mounting Height and Location: Signs with tactile characters shall comply with Section 11B-703.4.
 8. Doorways Leading to Sanitary Facilities: Provide Signs that Comply with Applicable Requirements of Sections 11B-703.7.2.6.
 9. Grade Level Exterior Exit Doors: Provide tactile exit signage to comply with 1011.1 and 11B-703.4.2.

C. EXTERIOR BUILDING METAL SIGNS. 18" high, Gil Sans Bold style.

2.2 MANUFACTURERS

- A. Signage products and manufacturers shall be as follows or equal as approved by Architect with products in conformance with specification requirements.
 1. Metal Plaque Signs: "Braille-Tac Etched Magnesium" ("Chemsast") by Advance Corporation, Braille-Tac Division, Cottage Grove, MN, 800-328-9451
 - a. Product: Braille-Tac Etched Magnesium (Chemsast).
 2. Plastic Plaque Signs: 100 Series by Vomar Products, Inc., Canoga Park, CA, 818-610-5115
 3. Vinyl Graphics: "3M Premium Grade Vinyl" by 3M, Commercial Products Division, St. Paul, MN, 800-374- 6772
 4. Luminescent Exit Signs: Active Safety, 408-625-6151.

2.3 MATERIALS AND COMPONENTS

- A. General:
 1. Not all materials required for fabrication of signage are specified herein and not all specified materials will necessarily be required.
 2. Screen Printing:
 - a. Inks shall have a light fastness rating of 7-8 on the din 16525 or industry standard.
 - b. Ink type shall be acceptable to the manufacturer of the substrate used.

- c. Screens shall be 254 polyester monofilament mesh tensioned to no less than 18 newtons.
 - d. Ink coverage shall be even, uniform and opaque.
 3. Comply with requirements indicated for material, thickness, finish, color, design, size and details of construction.
- B. Photopolymer: BASF or Jet.
- C. Acrylic Sheet: ASTM D702, Type III.
- D. Vinyl at Exterior: Opaque non-reflective film with pressure sensitive adhesive backing, suitable for exterior applications.
- E. High Molecular Acrylic Sheet: Nevamar "Vitricor."
- F. Colored Coatings for Acrylic Plastic Sheet: Use nonfading colored coatings, including inks and paints for copy and background colors, which are recommended by acrylic manufacturer for optimum adherence to surface.
- G. Mounting Tapes:
 1. Double-sided urethane foam tape, 3M #4016, or equal.
 2. Double-sided acrylic foam: 3M "VHB" Series, or equal.
- H. Silk-Screen Ink: Opaque enamel; Series 1100 "Sty-Ra-Lac," by Naz-Dar, Matthews Screen "MAP," or equal. Screen materials and methods to be in accordance with manufacturer's specifications.
- I. Anchors and Inserts: Nonferrous metal or hot-dipped galvanized anchors and inserts as required for corrosion resistance.
- J. Adhesive: As recommended by sign manufacturer.
- K. Baked Enamel Finish: Manufacturer's standard baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

2.4 PLASTIC SIGNS

- A. General:
 1. Signs shall be 0.25 inch thick solid acrylic plastic with permanent integral color and satin matte finish face.
 2. Type image shall be fused to the plastic under heat and pressure to 0.005 inch depth.
- B. Accessible Rest Room Signs: Laminated colored plastic, 1/4 inch thick, core color contrasting with exterior face color and texture; or acrylic plastic with inset symbols.
 1. Door Plaques:
 - a. Unisex Toilet: Equilateral triangle mounted on a 12-inch circle with both international male and female figures, and wheelchair figure.
 2. Wall Plaques: International male and female figure, wheelchair figure, and both upper case and Grade 2 Braille lettering.
- C. Maximum Occupancy Signs at Assembly Areas: Minimum 8 inches high x 12 inches wide, larger if required to accommodate text.
 1. Layout: Copy as required by CBC with occupancy numbers to be provided by District's Representative.

- D. Emergency Evacuation Signs: As required by CBC.
- E. Exit Signs:
 - 1. Illuminated Exit Signs: As shown on Drawings and specified in Division 26.
 - 2. Tactile Exit Signs: As required by regulatory requirements.
- F. Electrical, Mechanical and Other Code Required Room Identification Signs. As shown.

2.5 METAL SIGNS

- A. Exterior Dimensional Characters: Cast aluminum, F-214 alloy, with a satin polish.
 - 1. Finish: Clear anodized.
 - 2. 24" high; lettering as shown.
 - 3. Stud mounted projected spacers. Provide 2- 3 studs as required for shape of the number.
 - 4. 0.125" (1/8") thick

2.6 GRAPHIC LAYOUTS

- A. Text and Layouts: As shown and scheduled on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which signage is to be installed.
- B. Verify that substrate has been properly prepared and that surfaces are cured.
- C. Beginning installation signifies acceptance of substrates and conditions.

3.2 INSTALLATION

- A. General:
 - 1. Use concealed mounting in compliance with manufacturer's instructions.
 - 2. Install signs level and plumb at height indicated, with sign surfaces free from distortion or other defects in appearance.
 - 3. Locate signage where shown and scheduled. Where location is not shown, locate as directed by District's Representative or required by code.
- B. Plaques: Mount to wall and door surfaces with specified mounting tape.
 - 1. Height: 60 inches above floor, unless otherwise shown, specified, or required by code.
 - 2. Door-Mounted Signs: Center on door.
 - 3. Wall-Mounted Signs:
 - a. Mount on wall on same side as latch side of door, except as otherwise shown or specified.
 - b. Tactile characters on signs shall be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finished floor or ground surface. Reference CBC Section and Figure 11B-703.4.1.
- C. Dimensional Characters: Mount characters using pins recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated.

1. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
2. Pins shall be of sufficient length for letters to project 1-1/2 inches from wall and with 1/2-inch clearance to wall surface.

3.3 FIELD QUALITY CONTROL

- A. Inspection: In accordance with CBC 11B-703.1.1.2 Inspection, signs shall be field inspected after installation and approved by the District's Representative prior to issuance of final certificate of occupancy. Inspection will include, but is not be limited to, verification that Braille dots and cells are property spaced and the size, proportion and type of raised characters are in compliance with building code requirements.
- B. Check items installed for correct placement and alignment before notifying the District's Representative that installation in any area is complete.
 1. Installed signs shall be clean, properly aligned, level and true to line and dimension, flush to surface or as detailed and specified, free of excess visible adhesive, if used.
 2. Damage to sign of surrounding surface or other imperfections will not be accepted.
 3. No labels shall be adhered to the signs.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, clean soiled surfaces in accordance with the manufacturer's instructions.
- B. Protect signage from damage until acceptance by District.

END OF SECTION

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SECTION 10 2600
WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. The following types of wall protection systems:
 - a. Stainless steel corner guards
 - 2. Installation accessories.
- B. Related Requirements:
 - 1. Gypsum Board: Section 09 2900.
 - 2. Resilient Flooring: Section 09 6500; resilient base.
 - 3. Painting and Coating: Section 09 9000; painting of surfaces to receive protection products.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's catalog cuts and data sheets, including installation details and instructions, for each item specified.
- B. Samples:
 - 1. Initial Samples: Complete chart of manufacturer's available colors and textures for selection by Architect.
 - 2. Verification Samples: Submit in selected color and texture.
 - a. 6-inch section long section of corner guard .
 - b. 6-inch-square samples of high-impact wall covering.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Quality Control: Manufacturer's certification that PETG products meet specified physical and performance requirements. Results of tests specified shall accompany certification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials in manufacturer's original, unopened packages, clearly identified with manufacturer's name, brand name, quality or grade, and fire hazard classification.
- B. Store materials between 45 and 85 degrees F.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

PART 2 - PRODUCTS

2.1 MANUFACTURERS / MATERIALS

- A. Surface mounted stainless corner guard CG-1M by Life Science Products, Inc. as basis of design, or equal:
 - 1. Crimped edges
 - 2. 16 gauge type 304 stainless steel
 - 3. #4 polish finish
 - 4. Mechanical mount holes 12" O.C., countersunk
 - 5. Mounting hardware as recommended by manufacturer
 - 6. Radius bend requirements at corners: 1/8"
 - 7. Wing width: (2" x 2";)
 - 8. Height: 4' length mounted with top at 4'-6" a.f.f.
- B. Stainless-steel sheet: ASTM A 240/A 240M.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 FABRICATION

- A. Fabricate from one piece of stainless, formed to shape.

2.3 METAL FINISHES

- A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Remove tool and die marks and stretch lines or blend into finish.
 - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
 - 3. Finish exposed stainless steel surfaces with a NAAMM No. 4, stain finish with grain parallel to length of component.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect finished exposed surfaces from damage with a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. After finish painting of walls is complete, examine areas and conditions under which protection are to be installed.

3.2 PREPARATION

- A. Painted areas to receive protection shall be lightly sanded then wiped down to assure a dust-free surface.

3.3 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's installation instructions and as shown on the Drawings, to match accepted mockups.
2. Install level and true to line without distortion to variation of plus or minus 1/8 inch over 10 feet; variation shall not be cumulative.
3. Acclimate to temperature conditions within range required by manufacturer prior to installation as required by manufacturer.

3.4 ADJUSTMENT AND CLEANING

- #### A. Prior to time of final acceptance, strip protective coverings, and clean in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 10 2813
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. District-furnished, Contractor-installed toilet accessories.
 - 2. Contractor furnished and installed toilet and janitorial accessories.
- B. Related Requirements:
 - 1. Glazing: Section 08 8000; unframed mirrors.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's catalog cuts and data sheets, complete parts list, and installation requirements for each accessory item specified.
- B. Schedule: Indicate type, quantities, sizes, and locations for accessories.
- C. Samples: Only as requested by Architect. Accepted samples may be installed as part of finished work.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data and operating instructions.
- B. Keys required for each type of equipment and lock.

1.5 WARRANTY

- A. Manufacturer: Furnish District a written warranty for mirrors against silver spoilage for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products listed are by Bobrick unless otherwise noted.

- B. Other Acceptable Manufacturers:
 - 1. American Specialties, Inc: www.americanspecialties.com.
 - 2. Bradley Corporation: www.bradleycorp.com.
- C. Substitutions: Section 01 6200 – “Product Options and Substitutions”.

2.2 DISTRICT-FURNISHED AND INSTALLED ACCESSORIES

- A. Paper Towel Dispenser – Mfr. and model to be confirmed by District
- B. Wall-Mounted Soap Dispensers:
 - 1. Vertical: Bobrick B-2111.
 - 2. Horizontal: Bobrick B-2112.
- C. Waste Receptacle

2.3 CONTRACTOR FURNISHED AND INSTALLED ACCESSORIES

- A. General:
 - 1. Manufacturers and models are listed with each accessory. Where noted “no substitution,” provide the specified product. No substitution is permitted.
 - 2. Locked Dispensing Units: Key in accordance with instructions provided by District.
 - 3. Finish on Each Accessory: As specified.
- B. Clothes Hook: Bobrick B-7672.
- C. Grab Bar 42" Long: Bobrick B-5806 x 42.
- D. Grab Bar 48" Long: Bobrick B-5806 x 48.
- E. Combination Sanitary Napkin/Tampon Dispenser: Bobrick B-3500.25
 - 1. Operation: 25 cent coin required to operate dispenser.
 - 2. Provide locked coin box, separately keyed.
 - 3. Minimum capacity: 31 napkins and 22 tampons.
- F. Sanitary Napkin Disposal, Surface Mounted: Bobrick B-270.
- G. Toilet Paper Dispenser, Recessed: Bobrick B-4388.
- H. Seat Cover Dispenser: Bobrick B-221.
- I. Shelf with Mop and Broom Holder: Bobrick B-224.
- J. Mirror: Bobrick B-165, size as scheduled.
- K. Baby Changing Station: Koala Kare KB110-SSRE Stainless steel wall mounted horizontal recessed changing station.
- L. Pipe Wrap at Exposed Undercounter Plumbing: Flexible vinyl; “Lav-Guard 2” by Truebro Inc., Collierville, TN, 800-340-5969.
 - 1. Series: As recommended by manufacturer for pipe trap type.
 - 2. Color: White.

M. Keys:

1. Provide universal keys for access to toilet accessory units requiring internal access for servicing and supply.
2. Provide minimum 4 sets keys to Owner.

2.4 INSTALLATION ACCESSORIES

- A. Fasteners: Screws, bolts, and other devices shall be of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check substrates and recesses for correct dimensions, plumbness of blocking or frames, and preparation and also other conditions that would affect installation of accessories.
- B. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.

3.2 INSTALLATION

- A. Install accessories in locations and at heights indicated on the Drawings.
- B. Install accessories in accordance with manufacturer's recommendations and code accessibility requirements, plumb, true to line, complete with all required fasteners and accessories, securely anchored to backing, blocking, or building structure.
- C. Drill holes to correct size. Cut openings for recessed items with 1/4-inch tolerance so that cut is concealed by flange after application of item.
- D. Mount recessed accessories into wall openings with wood screws through cabinet side into wood blocking or sheet metal screws into metal blocking or backing.
- E. Mount surface-mounted accessories to solid backing or blocking; plumb and align.
- F. Sealants: Comply with requirements of Section 07 9200, "Joint Sealants."
 1. Apply behind toilet accessories as necessary to ensure sanitary and watertight integrity of surfaces.
 2. Conceal sealants.
- G. Framed Mirrors: Secure to concealed wall hanger in accordance with manufacturer's instructions for theft-resistant mounting.
- H. Attach grab bars to backing installed in walls to withstand loads prescribed by CBC.

3.3 ADJUST AND CLEAN

- A. Remove protective coverings in accordance with manufacturer's instructions.
- B. Adjust accessories for proper operation.
- C. After completion of installation, clean and polish exposed surfaces.

- D. Deliver keys and instruction sheets to Owner.

END OF SECTION

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SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Hangers for surface mounted fire extinguishers.
- B. Related Requirements:
 - 1. Fire Suppression: Division 21.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout Procedures," and Section 01 7800, "Project Records Documents."

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for fire extinguishers and cabinets to be used.

1.4 CLOSEOUT SUBMITTALS

- A. Specified warranty.

1.5 QUALITY ASSURANCE

- A. Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- B. Fire extinguishers shall be listed and labeled for type, rating, and classification by Factory Mutual (FM) or another independent testing agency acceptable to authorities having jurisdiction and to Owner's insurance company.

1.6 WARRANTY

- A. Manufacturer: Furnish District with manufacturer's 6-year written warranty in which manufacturer agrees to repair or replace fire extinguishers that fails in materials or workmanship within specified warranty period. Failure includes, but is not limited to, the following:
 - 1. Failure of hydrostatic test according to NFPA 10.
 - 2. Faulty operation of valves or release levers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Larsen's Manufacturing Co: www.larsensmfg.com.
- B. Acceptable Manufacturers:
 - 1. Potter-Roemer; www.potterroemer.com.
 - 2. JL Industries, Inc: www.jlindustries.com.
 - 3. Or equal.

2.2 DESIGN AND PERFORMANCE CRITERIA

- A. Fire extinguishers and cabinets shall be furnished from only one manufacturer.
- B. Fire extinguishers shall be UL listed, conforming with ANSI/UL 711, and bear UL "Listing Mark" for type, rating, and classification of extinguisher.
- C. Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- D. Cabinets shall meet "ADA Standards for Accessible Design" and CBC requirements for mounting height and projection from wall. Comply with the most stringent.
- E. Fire Extinguishing Agent: Provide clean agent which does not contain halons or HCFCs.

2.3 EQUIPMENT

- A. Fire Extinguishers:
 - 1. Typical: Multipurpose dry chemical type, 5-pound capacity, UL Rating 2A-10B:C; Larsen's MP5.
- B. Fire Extinguisher Cabinets: "Architectural" Series #2406-6R by Larsen's, or equal.
 - 1. Cabinet:
 - a. Type: Semi-Recessed, steel construction.
 - b. Inside Dimensions: 9-1/2 inches wide by 24 inches high by 6 inches deep.
 - c. Cabinet Trim: 2-1/2 inch rolled edge.
 - 2. Door Style: Vertical duo with clear tempered glass.
 - 3. Latching Device: Manufacturers "SAF-T-LOK" cam lock.
 - 4. Finish on Door, Trim and Box: Shop-applied electrostatic white powder coat.
 - 5. Lettering: Vertical, red.
 - 6. At Rated Partitions: Where continuity of fire-rated wall assembly is not shown, provide cabinet as above, but provide rated box.
 - 7. Provide mounting clips, suitable for extinguishers being provided, in each cabinet.
- C. Mounting Brackets for Surface-Mounted Extinguishers in Utility and Equipment Rooms: Manufacturer's standard steel bracket with powder coat paint finish and additional straps designed to secure fire extinguisher to wall or structure and prevent accidental dislodgement, of sizes required for types and capacities of fire extinguishers specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fire extinguisher cabinets shall be located where shown and as required by the local fire department. Wherever exact location of units is not shown, assume one extinguisher per 75-foot radius (maximum 75-foot travel distance from any given point to an extinguisher). Exact locations shall be approved by the District's Representative.
- B. Install fire-rated cabinets in rated walls as required to maintain fire separation integrity of partition.
- C. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.
- D. Provide fire extinguisher in each fire extinguisher cabinet plus an additional 10 percent of each size for future use by District.
- E. Provide specified mounting brackets for extinguishers located in rooms accessed by authorized personnel only and not located in cabinets.
- F. Inspect, charge, and tag the fire extinguishers within 30 days before date of inspection by fire department.

END OF SECTION

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SECTION 10 5113

METAL LOCKERS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. SCOPE: Furnish and install steel lockers, accessories and finish metal trim as shown or indicated on approved drawings. Concrete or masonry bases, wood furring, blocking or trim as may be required by drawings are included in other sections of this specification.
- B. Related Work Specified Elsewhere:
 - 1. 05 4100 – Structural Metal Stud Framing
 - 2. 05 5000 – Metal Fabrications
 - 3. 09 2900 - Gypsum Board.

1.2 SUBMITTALS:

- A. Shop Drawings: Submit drawings showing locker types, sizes and quantities, including all necessary details relating to anchoring, trim installation and relationship to adjacent surfaces.
- B. Numbering: The locker numbering sequence shall be provided by the approving authority and noted on approved drawings returned to the locker contractor.
- C. Color Charts: Provide color charts and samples of paint on metal showing manufacturer's available colors.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project: leed@lyonworkspace.com
 - 1. Reduced Site Disturbance: Development Footprint – Credit 5.2
 - 2. Recycled Content: MR Credits 4.1 and 4.2
 - 3. Regionally-sourced Products: MR Credits 5.1 and 5.2
 - 4. Low-Emitting Materials Painting: VOC-Compliant Paints and Coatings Credit 4.2

1.3 QUALITY ASSURANCE:

- A. Uniformity: Provide each type of metal locker as produced by a single manufacturer, including necessary accessories, fittings and fasteners.
- B. Job Conditions: Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage and installation.

1.4 WARRANTY:

- A. Warranty shall cover against all defects in materials and workmanship excluding finish, damage resulting from deliberate destruction and vandalism, for a period of two years.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

- A. Basis of Design Manufacturer: Lyon LLC, PO Box 671, Aurora, Illinois 60507. Toll Free (800) 323-0082. Phone (630) 892-8941. Web Site www.lyonworkspace.com.
- B. Acceptable Manufacturers:
 - 1. Penco Heavy duty welded lockers.
 - 2. ASI Heavy-duty welded lockers.

2.2 HEAVY-DUTY STEEL LOCKERS:

- A. Type 1:
 - 1. Configuration: Single row, 4 tiers
 - 2. Size: 12" wide x 18" deep
 - 3. Openings: 16
 - 4. Padlock hasp
- B. Type 2:
 - 1. Configuration Size: Single row, 4 tiers
 - 2. Size: 15" wide x 18" deep
 - 3. Openings: 16
 - 4. Padlock hasp
 - 5. Accessible units: 2
- C. Construction: All lockers shall be pre-assembled, with all seams and joints welded for rigidity and durability
- D. Material: Prime, high grade Class 1 mild annealed, cold-rolled steel free from surface imperfections. ASTM A1008. Bolts to be zinc plated or subjected to other rust-retardant treatment.
- E. Fabricate lockers square, rigid and without warp, with metal faces flat and free from dents or distortion. Make all exposed metal edges safe to touch. Weld frame members together to form rigid, one-piece structure. Weld, bolt, or rivet other joints and connections as standard with manufacturer. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames except for fastening of number plates and recessed handle.
- F. Finishing: All locker parts to be cleaned and coated after fabrication with a seven stage zinc/iron phosphate solution to inhibit corrosion, followed by a coat of high grade custom blend powder electrostatically sprayed and baked at 350 degrees Fahrenheit for a minimum of 20 minutes to provide a tough durable finish. Color to be selected from manufacturer's standard list of colors..
- G. Body:
 - 1. 16-gauge steel.
 - 2. Flanged to give double thickness of metal at seams, joints, and corners.
 - 3. Back: 18-gauge steel.
- H. Door Frame:
 - 1. 16-gauge formed-steel channels.
 - 2. Vertical Members: Additional flange to form continuous door strike.
 - 3. Corners: Lapped and welded into rigid assembly.
 - 4. Bottom Cross Members: Tang at each end that fits through slot in rear flange of upright frame member to prevent twisting out of alignment.
 - 5. Top and Bottom Cross Members: Provide support for front edge of locker top and bottom,

- I. Doors:
 - 1. 1-piece, 14-gauge steel.
 - 2. Multiple-Tier Locker Doors: Hinge side formed into channel-shaped formation with other 3 sides flanged at 90-degree angle.
- J. Ventilation:
 - 1. Multiple-Tier Lockers:
 - 2. 12 Inches and 15 Inches Wide: Three 3-1/2-inch louvers per door.
- K. Hinges:
 - 1. Height: Minimum of 2 inches.
 - 2. Type: 0.050-inch thick steel, 5-knuckle, full-loop hinge forming double thickness on each leaf.
 - 3. Attachment: Set hinges in slot in door and frame and projection welded to frame and securely attached to door.
 - 4. Hinge Pin: Spun over at ends to resist removal.
 - 5. Specified configuration to have two hinges.
 - 6. Mounting: Right-hand side of door.
- L. Locking Device:
 - 1. Specified multiple tier lockers shall be equipped with a 14-gauge steel lock clip for padlock attachment. Padlock to be OFOI.
- M. Handles:
 - 1. Door Pulls:
 - a. Multiple-tier lockers.
 - b. 16-gauge steel door pull with padlock attachment, when not used with built-in locks.
 - c. Roll-point catch

2.3 LOCKER ACCESSORIES:

- A. 4" Continuous Z-Base: Shall be fabricated from 14-gauge cold rolled sheet steel fabricated in 72" lengths, flanged at the top to form a 1-3/8" toe space and at the bottom allowing concealed fastening to the finished floor. Continuous Front Bases include holes for use with splice plates where bases are joined end-to-end. Finish to match lockers.
- B. Fillers and Closure Panels:
 - 1. Top closures, closure strips, front expansion fillers, and corner fillers to fill gap between top of locker and soffit above.
 - 2. Fill spaces between lockers and walls as required for proper fit.
- C. Number Plates: Aluminum number plates 2-3/8" x 1" with etched figures at least 3/8" high. All lockers shall have number plates attached in prepunched holes near top of door.
- D. Floor anchoring: Anchor lockers to floor in accordance with manufacturer's instructions.

2.4 FINISH:

- A. General: Factory apply finish in accordance with manufacturer's instructions.
- B. Standard Finish: Exposed steel parts shall be thoroughly cleaned, given bonding and rust-inhibitive phosphate treatment, and electrostatically sprayed with powder coat. Baked-on finish.
- C. Color:
 - 1. Exterior Color: To be selected by Architect from full line of manufacturer's Premier Colors.

2. Interior Color: Match exterior color

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Lockers must be installed in accordance with manufacturer's approved drawings and assembly instructions. Installation to be level and plumb with flush surfaces and rigid attachment to anchoring surfaces.
 1. Space fasteners at 36" o.c. or less as recommended by manufacturer. Use fasteners appropriate to load and anchoring substratum. Use reinforcing plates wherever fasteners could distort metal.
 2. Various trim accessories where shown such closure panels, fillers, bases, recess trim, etc., shall be installed using concealed fasteners. Flush, hairline joints are provided at all abutting trim parts and at adjoining surfaces

3.2 ADJUSTMENT:

- A. Upon completion of installation, inspect lockers and adjust as necessary for proper door and locking mechanism operation. Touch up scratches and abrasions to match original finish.

END OF SECTION

SECTION 11 1630

LOCK BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior recessed lock boxes for emergency Building access.
- B. Related Requirements:
 - 1. Joint Sealants: Section 07 9200.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Coordination: Contractor shall obtain required forms from manufacturer and forward them to the Fire Department for signature. Manufacturer will not ship lock boxes until they receive executed forms from the Fire Department.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's specifications, standard detail drawings, and installation instructions.
- B. Certificates: Manufacturer's forms signed by Milpitas Fire Department.
- C. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification goals for this Project.

1.4 FIELD CONDITIONS

- A. Location of lock box, if shown, is approximate. Verify exact location where lock box is required with Fire Department. Location shall be approved by District's Representative prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lock Box: Extra-heavy-duty, recessed, steel; "Knox-Box" Model 4400-R with "RMK" mounting kit as manufactured by The Knox Company, Phoenix, AZ, 800-552-5669.
 - 1. Size: 7 inches wide x 7 inches high x 5 inches deep with 9-1/2-inch square flange.
 - 2. Door shall be weatherstripped.
 - 3. Finish: Manufacturer's standard primer and polyester powder coat.
 - a. Color: Custom, as selected by District's Representative.
- B. Stickers: Provide as required by the Fire Department to identify box and /or to inform Department of box locations.

- C. Silicone Sealant: One-part, neutral-cure, gun grade, as specified in Section 07 9200, "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lock box in accordance with manufacturer's instructions.
- B. Seal around lock box frame, if required, with silicone sealant.
- C. If used, after installing the box apply stickers at locations approved by Fire Department.

END OF SECTION

SECTION 12 2413

ROLLER SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually-operated single shade system.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout" and 01 7800 "Project Records Documents".

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Submit for each mounting condition and each location, showing brackets, anchorage to substrate, and relationship to adjacent materials. Manufacturer's standard details, if representative of actual field conditions, are acceptable.
 - 2. Show field-measured dimensions of openings scheduled to receive shades.
- B. Product Data: Manufacturer's descriptive literature of controls, accessories, attachment brackets, and installation instructions. Include test reports from a qualified testing agency for each shade cloth verifying compliance with specified performance criteria.
- C. Samples:
 - 1. Shadecloth: Minimum 12-inch square of each shade material. Mark face of material to indicate interior faces.
 - 2. Aluminum finish as selected.
- D. Shades Schedule:
 - 1. Use same designations for openings or Room as indicated on Drawings.
 - 2. Show field-measured dimensions of openings scheduled to receive shades.
- E. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's qualifications.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturer's recommended maintenance procedures for each type of shade, and two sets of any special tools that are required for inclusion in District's Operations and Maintenance Manual.
- B. Extended warranties.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer: Employee of shade manufacturer or certified in writing by manufacturer as an acceptable installer of shade system.
 - 2. Manufacturer: Continuously engaged in manufacturing commercial window shades of the types required for not less than 10 years prior to date of this Contract.
- B. Source Limitations:
 - 1. The system shall be furnished by a single-source supplier with a certification that all components including shade fabrics and will be available in the future for either replacement or add-on requirements.
 - 2. Each type of shadecloth shall be woven of the same yarns, have similar weaves, and shall be color matched by dye lot.
 - 3. Furnish shadecloth of the same dye lot for each area.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.
- B. Comply with additional requirements specified in Section 01 6100, "Material and Equipment".

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on shop drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify District's Representative of installation conditions that vary from Drawings.

1.9 WARRANTY

- A. Manufacturer: Furnish District with the following manufacturer warranties.
 - 1. Tracks, Gear-and-Sprocket Mechanism, and Accessories: 5 years against defects in materials and workmanship which inhibit proper and intended functioning of products.
 - 2. Shadecloth: 10 years with the provision that it will not deteriorate, sag or warp and will remain fit for use for the full warranty period.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Each shade shall extend the full height and width of the window opening where it occurs.
- B. Drive Assembly:
 - 1. Shall be factory set for size and travel of shades.
 - 2. Shall be adjustable from exterior of shade unit without disassembly of hardware.
 - 3. Shall have a built-in shock absorber system to prevent chain breakage under normal usage conditions.

- C. Removal of shade shall not require disassembly of shade unit.
- D. Shade Cloth:
 - 1. Shade cloth shall hang flat, without buckling or distortion.
 - 2. Edge, when trimmed, shall hang straight without raveling.
 - 3. An unguided roller shade cloth shall hang true and straight, without shifting sideways more than 1/8 inch in either direction due to warp distortion or weave design.
 - 4. Flame Retardance: Shade fabric shall be certified by an independent testing laboratory to pass NFPA 701 and applicable code requirements.
 - 5. Each type of shadecloth shall be woven of the same yarns, have similar weaves, and shall be color matched by dye lot.
 - 6. Furnish shadecloth of the same dye lot for each area.
 - 7. Shades shall have no seams, except where approved in advance in writing by District's Representative.

2.2 ROLLER WINDOW SHADE SYSTEM

- A. Manufacturers:
 - 1. Basis of Design: MechoShades Systems Inc.,
 - 2. Acceptable manufacturer: Draper Flexshade provided equivalent product is available.
 - 3. District Standard – No substitutions accepted.
- B. Operation: Hand chain
- C. Configuration: Single shade system, top down.

2.3 MATERIALS AND COMPONENTS

- A. Shade Materials:
 - 1. Environmentally-Certified Visually Transparent Shadecloth for Sun Control: Ecoveil 1350 Series; basket-weave pattern at 5% Open Factor.
 - a. 100% Thermoplastic Olefin (TPO) for both core yarn and jacket, single thickness, non-raveling 0.034 inch thick fabric, PVC-free.
 - b. Color: 1369 Silver Birch is preliminary selection. Submit full swatch of available colors for Architect's final selection.
- B. Shade Pocket: For recessed mounting where indicated on the Drawings.
 - 1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
 - 2. Closure and closure mount with tile and gypsum board support dimension as required.
 - 3. Finish to match ceiling. Color to be selected by Architect.
 - 4. Refer to the Drawings for additional requirements for recessed pockets.
- C. Exposed Mounting: For exposed mounting where indicated on the Drawings.
 - 1. Standard mounting with fascia trim permitting wall mounting, easy removal and replacement without damaging roller shade or adjacent surfaces.
 - 2. Closure and closure mount with tile and gypsum board support dimension as required.
 - 3. Finish to match adjacent surfaces. Color to be selected by Architect.
 - 4. Refer Drawings for additional requirements for surface-mounted pockets.
- D. Bottom Bar: Extruded aluminum weight in a sealed fabric hem pocket.
- E. Drive Assembly for Manual Shades: Engineered heavy duty chain drive pulley operating system consisting of metal clutch housing and locking plug.

1. Chain tensioner to be compliant with WCMA safety standard A100.1 and shall prevent the clutch system from moving the roller shade through lowering and raising if not properly installed as specified in ANSI Standard Section 6.5.2.
 2. Components will be maintenance free from adjustments or lubrication for trouble-free operation
 3. Factory set for size and travel of shades.
 4. Capable of field adjustment from the exterior of the shade unit without disassembling the hardware.
 5. Provided with a built-in shock absorber system to prevent chain breakage under normal use conditions.
 6. Provide manufacturer's "Lift-Assist Mechanism" (LAM) at manual shades exceeding 10 pounds but not over 20 pounds.
- F. Chain Operator: No. 10 stainless steel bead chain formed in a continuous loop with a rated 90 pound minimum breaking strength.
1. Nickel plate chain will not be accepted.
 2. Provide chain holder to be secured attached to wall, mullion or location approved by Architect.
- G. Brackets, Fastenings, and Accessories: As detailed, or if not detailed, as recommended by shade manufacturer for conditions indicated on the Drawings or encountered.
1. Brackets shall be designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.
 2. No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- H. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material.
1. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.
 2. Direction of Roll: Regular, from back of roller.
- I. Miscellaneous Fastenings, and Accessories: As shown, or if not shown, as recommended by shade manufacturer for conditions indicated on the Drawings or encountered.

2.4 FABRICATION

- A. Fabric shall be attached to rollers by double wide staples. No adhesive is allowed.
- B. Coordinate pocket closure trim as shown on the Drawings with fabrication of aluminum curtain wall and storefront framing.
- C. Factory Finish on Exposed Aluminum: Polyvinylidene fluoride paint system using PVDF resin.
 1. Color: Custom, to match aluminum window framing, unless otherwise selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and openings to receive shades and conditions under which they are to be installed.

3.2 INSTALLATION

- A. Install shades in accordance with manufacturer's installation instructions.
 - 1. Mount as shown on the Drawings.
 - 2. Assure adequate clearance to permit unencumbered operation.
 - 3. Position units plumb and true, and securely anchor in place with brackets, clips, and fasteners.
 - 4. Allow for proper alignment of shade cloth and height of pocket to ensure bottom of shade cloth will align with bottom of pocket when shade cloth is fully retracted.
- B. Each shade shall extend the full height and width of the window opening where it occurs.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures roller shades are without damage or deterioration at time of acceptance.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of final completion.

END OF SECTION

SECTION 12 3661

SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid plastic countertops with matching splashes.
 - 2. Solid epoxy resin countertops with matching splashes.
- B. Related Requirements:
 - 1. Architectural Wood Casework: Section 06 4100.
 - 2. Joint Sealants: Section 07 9200.
 - 3. Plumbing: Division 22.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
 - 1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
 - 2. Closeout Submittals shall be submitted in accordance with Section 01 7000, "Contract Closeout Procedures," and Section 01 7800, "Project Records Documents."
- B. Coordinate delivery with fabrication and installation of supporting casework and underlayment.
- C. Coordinate openings and penetrations in countertops with information provided under other Sections and as Scheduled.

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Show layout for each countertop, joint locations, splashes, edge profiles, and field-verified dimensions.
 - 2. Coordinate preparation of shop drawings with casework shop drawings.
 - 3. Identify color and pattern of solid surfacing for each location and type.
- B. Product Data: Manufacturer's descriptive literature and test reports substantiating that solid surfacing meets specified requirements.
- C. Samples:
 - 1. Minimum 6-inch-square piece of each pattern and color.
 - 2. Counter edge, 6-inches long, in required profile.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver certification for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Statement of fabricator qualifications.
- B. Evidence of certification of installer by manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Extended warranty.
- B. Manufacturer's recommended care and maintenance recommendations including recommended repair and cleaning instructions.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified by manufacturer of solid surfacing as an acceptable fabricator and installer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products until wet work, painting, and similar operations in storage and installation areas which could damage or soil work have been completed.
- B. Store in racks in near-vertical position away and from direct exposure to sun. Store with finished face toward finished face.
- C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 WARRANTY

- A. Manufacturer: Furnish Owner with manufacturer's extended 10-year warranty against defects in materials, fabrication, and installation. Warranty shall provide material and labor to repair or replace defective materials.

PART 2 - PRODUCTS

2.1 Design and Performance Criteria

- A. Flammability: Provide solid surfacing with a Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
- B. Solid Surfacing Materials: Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
 - 1. Conform to ANSI/CPA SS-1.
 - 2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

2.2 MATERIALS

- A. Solid Surfacing: Homogeneous, thermoset, polymer alloy sheet; "Corian" by Dupont as specified and the basis of design, or equal.
 - 1. Thickness: 1/2 inch.
 - 2. Color and Pattern: As selected by Architect.
- B. Solid Epoxy Resin: Factory molded of modified epoxy-resin formulation with smooth, non-specular finish.
 - 1. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi (70 MPa).

- b. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 deg F (127 deg C).
2. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
 3. Color: Black.
 4. Countertop Fabrication: Fabricate with factory cutouts for sinks and with butt joints assembled with epoxy adhesive and prefitted, concealed metal splines.
 - a. Select one of first three subparagraphs below; if selecting third, indicate configurations, including thicknesses, on Drawings.
 - b. Countertop Configuration: Flat, 1 inch thick, with beveled edge and corners, and with drip groove and integral coved backsplash.
 - c. Countertop Construction: Uniform throughout full thickness.

2.3 ACCESSORIES

- A. Substrate Supports: 3/4-inch thick continuous Exterior Grade plywood as recommended by manufacturer. Coordinate with fabrication of casework.
- B. Mounting Adhesive: Structural-grade silicone or epoxy of type recommended by manufacturer for application and conditions of use.
- C. Panel Joint Adhesive: Manufacturer's standard two-part epoxy or polyester to create flush, inconspicuous, monolithic, non-porous joints with a chemical bond, and in color to match adjacent solid surfacing.
- D. Perimeter Sealant: Silicone, as specified in Section 07 9200, "Joint Sealants," in color to match adjacent solid surfacing.
- E. Mounting Hardware:
 1. Fixtures: Manufacturer's approved bowl clips, brass inserts, and fasteners.
 2. Surfacing: Type and size as required and recommended by surfacing manufacturer.

2.4 FABRICATION

- A. General:
 1. Comply with applicable requirements of ISSFA-2 and printed instructions of manufacturer including those for treating cut edges, sanding, polishing, seaming and layering.
 2. To greatest extent possible, complete fabrication and assembly before shipment to site.
 3. Obtain field measurements, and verify dimensions before fabricating work.
- B. Fabricate to dimensions, profiles, and details indicated on the Drawings.
 1. Use a single piece wherever possible. Where multiple sheets are required, use sheets in consecutive order as numbered by manufacturer.
 2. Precut openings for applied fixtures and fittings, where possible. Cutouts shall be smooth and uniform without saw marks.
 3. Predrill mountings for applied hardware, where possible.
 4. Conceal all fasteners.

- C. Provide joints only where maximum available lengths or countertop configuration requires a joint.
 - 1. Install joints where shown on reviewed shop drawings, in accordance with manufacturer's instructions.
 - 2. Do not locate joints within 18 inches of a sink and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - 3. Joints shall be hard seamed. Provide 2-inch-wide seam blocks under seams in accordance with manufacturer's recommendations.
 - 4. Seal seams with specified joint adhesive, clamp tightly, and sand smooth.
 - 5. Finished joints shall be flush, monolithic, uniform, and nearly invisible.
- D. Fabricate countertops with integral front edge with profile shown on the Drawings, and with small-radius coved back and end splashes.
- E. Allowable Tolerances:
 - 1. Variation in Component Size: Plus or minus 1/4 inch.
 - 2. Location of Openings: Plus or minus 1/4 inch from indicated position.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that backing has been installed at appropriate locations for anchorage.
- B. Examine shop-fabricated work for completion. Complete work as required.

3.2 INSTALLATION

- A. Install countertops conforming to manufacturers recommended installation procedures, as shown on reviewed submittals.
- B. If field joints are required, make them in same manner as shop joints. Finished joints shall be flush, monolithic, uniform, and nearly invisible.
- C. Scribe and cut to fit adjoining work.
- D. Install work plumb, level, true, and straight, with no distortions. Install with no variation in flushness of adjoining surfaces. Shim as required, using concealed shims.
- E. Sealant:
 - 1. Use silicone sealant to attach back and end splashes, and to seal joints around plumbing fixtures.
 - 2. Install sealant as specified in Section 07 9200, "Joint Sealants," as required to close any small unavoidable gaps between counter and abutting surfaces.
 - 3. Sealant shall not be used to correct excessive joint size or scribing errors.

3.3 ADJUSTMENT

- A. Repair damaged and defective work to eliminate visual and functional defects. Where repair is not possible, replace work.
- B. Protect installed work from damage.

END OF SECTION

SECTION 13 3413
GREENHOUSE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Furnishing and erecting of the greenhouse superstructure including all polycarbonate glazing, doors, door hardware, and ventilation as shown on plans and/ or hereinafter described, such work to be the responsibility of the qualified greenhouse installer.
- B. Related Requirements:
1. Cast-in-Place Concrete: Section 03 3000
 2. Structural Steel Framing: Section 05 1200
 3. Metal Fabrications: Section 05 5000
 4. Hollow Metal Doors and Frames: Section 08 1113
 5. Door Hardware: 08 7100
 6. Plumbing Division 22
 7. Electrical Division 26

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
- B. Coordination:
1. Furnish setting drawings, diagrams, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors, to be embedded in concrete.
 2. Coordinate fabrication schedule with construction progress to avoid construction delays.
 3. Coordinate with other construction in order to ensure that actual dimensions correspond to established dimensions.
 4. All site conditions shall be correct and ready prior to greenhouse erection.
 5. No foundation or footer installation shall be done prior to approval of greenhouse shop drawings.
- C. Substitutions:
1. If another model of greenhouse is substituted, the manufacturer shall apply for permission to quote in accordance with Section 01 6200, "Product Options and Substitutions".

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Fully-detailed shop drawings for fabrication and erection of assemblies including equipment placement, covering and doors.
1. Show required field measurements and interface with work of other Sections.
 2. Provide structural prints and calculations sealed by a registered professional engineer in the state of California.
 3. Min. 6" square sample representing actual exterior finish material and covering.
- B. Product Data: Manufacturer's specifications for manufactured products to be used in the

fabrication of work, including paint products, bolts, and other exposed hardware.

- C. Sustainable Design: Information necessary to establish and document compliance with the LEED Silver goals for this Project.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum 5-year experience manufacturing similar products designed to meet state of California building code.
- B. Installer Qualifications:
 - 1. A qualified greenhouse specialty greenhouse contractor approved in writing by the manufacturer shall erect the greenhouse.
 - 2. The greenhouse contractor shall have at least five (5) years' experience in building greenhouses of the type specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacture's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Protect steel from corrosion.
- C. Comply with additional requirements specified in Section 01 6100, "Material and Equipment."

1.6 FIELD CONDITIONS

- A. Field Measurements: Where greenhouse layout and components are indicated to align with other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of design manufacture is Stuppy Greenhouse Manufacturing, Incorporated -- 1212 Clay, North Kansas City, MO - (800) 733-5025.
 - 1. The Greenhouse will be a 34' x 60' CS3 with 10' column and truss spacing. Sidewall height shall be 10 feet.
 - 2. The Shadehouse will be a 25' x 80' Rainbow Plus with 6' column and truss spacing. Sidewall height shall be 10 feet.
- B. Other approved manufacturers:
 - 1. Rough Bros. Inc. 5513 Vine St, Cincinnati, OH 45217 - (513) 242-0310
 - 2. Ludy Greenhouse Manufacturing Corporation, 122 Railroad Street, New Madison, OH (800) 255-5839

2.2 GREENHOUSE

A. Primary Structural Steel Members

1. All steel members shall comply with ASTM A500 dimensional tolerances.
2. Columns shall be fabricated from 4 inch by 2 inch steel with minimum yield strength of 50,000 psi. Columns will be manufactured with 10" x 10" base plates. Hot dipped galvanized after manufacturing. Include hilti epoxy, hilti epoxy gun, and threaded rod for installation.
3. Truss top cords will be fabricated from 3 inch by 2-inch steel with minimum yield strengths of 50,000 psi.
4. Truss bottom cords will be fabricated from 3 inch by 2-inch steel with minimum yield strengths of 50,000 psi.
5. Truss webbing will be fabricated from steel with minimum yield strengths of 50,000 psi. Truss webbing will be attached to top and bottom cords with aluminum connections to enhance corrosion resistance. (Standard is 1.5" square tubing)
6. Roof purlins will be 3 inch by 2-inch steel. Purlins will have a bolted connection to trusses.
7. End walls will be framed with 3 inch by 2-inch rectangular steel tubing with minimum yield strength of 50,000 psi.
8. Gutters are to be extruded aluminum
9. No wood members are required or allowed to complete structure.
10. No rolled form pipe or round columns allowed.

B. Doors and Frames

1. Double swing doors to consist of 36 inch leafs by 84 inches tall, steel insulated, accessible doors. Doors to be equipped with lever lock and heavy duty door closer.
2. 24"x24"x1" insulated tempered glass window installed in door.
3. All doors should be furnished with appropriate framing and hardware identified under Division 8.
4. Sliding doors to be 96 inches wide by 96 inches tall, steel and aluminum frame fitted with polycarbonate panels matching the greenhouse and include handle, rail and carrier sets.

C. Ventilation Equipment

1. Horizontal Air Flow Fans -- Acme HAF20A fans or equal. Quantity of (2) two to be installed.
2. Exhaust Fans -- American Coolair AL Series or equal - Quantity of (2) Two to be installed on end wall and quantity of (1) One to be installed on upper gable.
 - a. Fans must include automatic shutters, inlet/outlet guards, slant wall housings and belt tighteners.
 - b. Exhaust fans are to have aluminum fan blades; steel propeller fans are not acceptable.
 - c. Provide 1 ea. AL-24H single speed 115v/230v gable exhaust fan.
 - d. Provide 2 ea. AL-42L single speed 115v/230v end wall exhaust fans
3. Inlet Vents and Vent Operators
 - a. A single run of vents shall be made up of a top rail and bottom rail of extruded aluminum and bolted together in accordance with manufacturer instructions. All vents shall have provisions made at the hinge point to prevent creeping of the vents. Vent size to be 4 foot tall and 31 foot long. Vent opener to be manufactured by Wadsworth Controls -- VC100 ILS motor/gearbox with LST (master) vent control/override control. Unit is fully UL compliant.
 - b. Motorized Inlet Shutter LRW39E 39" x 39" inlet shutters are to be provided, Shutter's to be installed in the upper gable of structure. Motor and linkage to operate shutters (s) is to be included. Shutters and motor/linkages are to be manufactured by American Coolair.

- D. Cooling Equipment
 - 1. Evaporative pad system will consist of pads made of cross-fluted cellulose paper; distribution pipe and return system complete with pump.
 - 2. Distribution and return system to be American Coolair 6" Closed Top PVC System or equal.
 - 3. System is 4' tall x 31' long with 6" thick cooling pads.
 - 4. No wood support stringers are allowed.
- E. Heating Equipment
 - 1. Greenhouse is to be equipped with (2) Two Modine PTP200 power vented heaters.
 - 2. Heaters are to have stainless steel burners and heat exchangers.
 - 3. Heaters with aluminum or aluminized steel heat exchangers are not acceptable.
 - 4. Double walled stacking is to be included as well as appropriate heater hangers to mount the heaters.
 - 5. Heaters are sized for 50F degree rise over outside temperature.
- F. Environmental Controls
 - 1. Wadsworth Seed integrated control system with touchscreen interface and PC software link with WiFi and hand held device app access. Controller is to be complete with contractor panel and wiring diagram.
 - 2. Thermostat control is not acceptable.
- G. Covering Material
 - 1. Roof to be covered with diffused light corrugated polycarbonate, double skinned sheet min. 8mm thick.
 - 2. Sides and ends to be covered with clear corrugated polycarbonate, double skinned sheet min. 8mm thick.
 - 3. Polycarbonate panels are to be of virgin resin. Regrind is not acceptable.
 - 4. Polycarbonate panels must carry a minimum warranty of 15 years against yellowing.
 - 5. Provisions shall be made within the glazing system to handle expansion and contraction as required by the polycarbonate manufacturer.
 - 6. All extrusions are to be aluminum.
- H. Automatic Shade System
 - 1. Automatic shade system shall be slope/flat/slope profile designed for shade fabric panels to extend truss to truss.
 - 2. System shall be push/pull supported on stainless steel guide wires using a rack and pinion drive with perimeter seals.
 - 3. Curtain fabric shall be 57% shade factor with diffused light properties and closed weave design.
 - 4. LS Svensson Harmony 5747D-FR or equal.
 - 5. Fabric must be fire retardant.

2.3 SHADEHOUSE

- A. Primary Structural Steel Members
 - 1. All steel members shall comply with ASTM A500 dimensional tolerances.
 - 2. Steel will meet Allied Tube and Conduit "Gatorshield" specifications for corrosion resistance
 - 3. Columns shall be fabricated 2.875" OD 13 gauge high strength alloy steel with minimum yield strength of 60,000 psi.
 - 4. Truss top cords will be fabricated from 1.90" OD steel with minimum yield strengths of 50,000 psi.
 - 5. Truss bottom cords will be fabricated from 1.66" OD steel with minimum yield strengths of 50,000 psi.
 - 6. Truss webbing will be fabricated from 1.315" steel with minimum yield strengths

of 50,000 psi. Truss webbing will be attached to top and bottom cords with aluminum connections to enhance corrosion resistance.

7. Roof purlins will be 1.315" steel. Purlins will have a bolted connection to trusses.
8. End walls will be framed with 3 inch by 2-inch rectangular steel tubing with minimum yield strength of 50,000 psi.
9. No wood members are required or allowed to complete structure.
10. No rolled form pipe or round columns allowed.

B. Coverings

1. Roof to be covered with black knitted 70% shade fabric.
2. Sides and ends to be covered with black knitted 70% shade fabric.
3. All extrusions are to be aluminum

PART 3 - EXECUTION

3.1 WARRANTY

- A. Greenhouse shall have a warranty period of one year for defects of structural and glazing installation. Equipment in the greenhouse will carry the manufacturer's standard warranty for parts. Covering will also carry the manufacturer's standard warranty.

3.2 INSTRUCTION

- A. Approved representative of the greenhouse manufacturer to visit the job site a minimum of one time during construction to meet with building erectors and once after construction to meet with the owner for training. Three (3) sets of owners/operation manuals to be provided.

END OF SECTION

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SECTION 21 0000

FIRE PROTECTION

PART 1 - GENERAL

1.1 INCLUSION OF GENERAL CONDITIONS AND GENERAL REQUIREMENTS

- A. The Bidding Requirements, Contract Forms, General Conditions, Supplemental General Conditions, and Division 01 Sections apply to this Section as fully as if repeated herein.

1.2 SUMMARY

- A. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents. The system shall be installed in conformance with the current Edition of NFPA 13, Standard for Installation of Sprinkler Systems, as amended in CBC chapter 35. All materials utilized shall be UL Listed and Factory Mutual Approved. All materials installed shall adhere to the manufacturer's installation guidelines.
- B. Scope includes all labor, equipment, materials, tools, transportation, excavation and backfill, supervision, and services required to furnish and install a complete and properly operating engineered wet-pipe fire protection system. Wet-pipe fire protection system shall be installed in all areas of the buildings.
- C. Should any work or materials be not included in the Drawings or Specifications but is nevertheless necessary for the proper execution of the stated scope thereof or for full compliance with governing authorities, the Contractor shall understand such work and/or materials are required and shall perform all such work and furnish such material as fully as if it were particularly delineated or described.

1.3 REFERENCES

- A. American Society for Testing and Materials
 - 1. ASTM A 53, "Standard Specification for Pipe, Steel and Hot-Dipped, Zinc-Coated, Welded and Seamless"
 - 2. ASTM A 234, "Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperature Service"
- B. American National Standards Institute / American Society of Mechanical Engineers
 - 1. ANSI / ASME B 16.1, "Cast Iron Pipe Flanges and Pipe Flanged Fittings"
 - 2. ANSI / ASME B 16.4, "Cast Iron Threaded Fittings, Class 125 and Class 250"
- C. American National Standards Institute / National Fire Protection Association
 - 1. ANSI / NFPA 13-2019, "Installation of Sprinkler Systems" as amended in chapter 35, 2019 CBC.

1.4 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Fire extinguishers - see Section 10 4400 for fire extinguishers and cabinets requirements.
- B. Fire water supply - see Section 33 1000 for domestic water/fire water supply systems requirements.
- C. Finish painting - see Section 09 9000 for painting requirements.
- D. Basic electrical materials and methods - See Section 26 0500

- E. Fire protection specialties - see Section 10 4400
- F. Fire alarm system - see Section 28 3100.

1.5 CERTIFICATION

- A. All fire sprinkler system pipefitters responsible for installing, altering or repairing water-based fire protection systems shall require certification by the State Fire Marshal's office. For more information, refer to the State Fire Marshal's Information Bulletin 17-002: NEW Automatic Fire Extinguishing Systems Certification (Water-Based Fire Protection)

1.6 WET-PIPE SPRINKLER SYSTEM DESIGN

- A. The wet-pipe sprinkler system design for classrooms, lobbies, offices, restrooms, etc. shall be for a light hazard occupancy classification. Science classrooms, stages, kitchens, storage and machine rooms shall be for ordinary hazard, group 2 occupancy. Occupancy classification shall be verified with the State Fire Marshal.
- B. Design of the sprinkler system shall be based on total hydraulic balance to attain uniform density of spray, i.e. the pressure drop from point of connection to any one sprinkler head shall be just sufficient to produce the density of flow required for that head. Tolerances shall be as follows:
 - 1. +10%, -0% flow for most remote sprinkler in any area of application (remote or intermediate).
 - 2. + or - 10% flow for any other sprinkler, but in no case shall total flow for any area of application be less than specified density requirement.
- C. Calculations shall include:
 - 1. Pressure at every juncture from the remote locations to the source.
 - 2. Demand flow rate (gpm) through the point of connection to the main water supply.
 - 3. Demand gpm through the point of connection to the public utility main in the street.
 - 4. Simulated water flow at main riser.
 - 5. Main and branch pipe sizes.
 - 6. Minimum flow pressure at every sprinkler shall be 7 psig.
- D. Sprinkler spacing shall not exceed the limits allowed in NFPA 13.

1.7 SUBMITTALS

- A. All submittals shall be submitted under the provisions of Division 01 and as follows:
 - 1. Product Data
 - a. Submit manufacturer's product data for all fire sprinkler system components, in compliance with specifications.
 - b. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
 - 2. Shop Drawings.
 - a. Prepare shop drawings of complete fire sprinkler systems and submit to Architect for approval prior to fabrication or installation of any work. Use of Contract Drawings is not acceptable.
 - b. Obtain all necessary information regarding layout of piping, conduit, ductwork, lights and air outlets, etc., and place piping and sprinkler heads to avoid interferences. Head layout shall be symmetrical.
 - c. After award of Contract and prior to purchase of equipment, submit seven sets of shop drawings with specifications and hydraulic calculations to Architect and two sets to

- local jurisdiction having authority for fire prevention for review. Check shop drawings before forwarding to Architect and ascertain that submittals meet all requirements of drawings and specifications and conform to space conditions.
- d. After integrating Architect's and local jurisdiction's comments into drawings, the fire protection Engineer of Record submitting fire sprinkler system design construction documents shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
 - e. Submit stamped documents to area office and local jurisdiction having authority for fire prevention for final approval. After final approval, submit four copies of approved stamped documents to Architect.
 - f. Failure of system to meet requirements of authority having jurisdiction shall be corrected at no additional cost to Owner.
3. Hydraulic Calculations & Test Data
 - a. Calculations as indicated herein.
 4. Operation And Maintenance Data (Refer to Division 01 for additional O&M Manual Requirements)
 - a. Provide master index showing items included.
 - b. Provide name, address, and phone number of Architect, Architect's Fire Sprinkler Consultant, General Contractor, and Fire Protection subcontractor.
 - c. Provide operating instructions to include general description of fire protection system and step-by-step procedure to follow in putting system into operation.
 - d. Maintenance instructions shall include a list of system components used indicating name and model of each item and manufacturer's maintenance instructions for each component installed in Project. Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
 - e. Include copies of approved shop drawings and copies of required warranties.
 - f. Include copies of NFPA 25, "Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems", 2017 California Edition.

1.8 QUALITY CONTROL

- A. Qualifications:
 1. A State of California Licensed C-16 Contractor shall install all fire sprinkler system components, including underground lines and overhead lines. Furnish verified list of similar projects installed during past 5 years.
- B. Requirements of Regulatory Agencies
 1. Unless noted otherwise, system shall conform to:
 - a. ANSI / NFPA 13, 2019 - "Light & Ordinary Hazard Occupancies"
 - b. ANSI / NFPA 24, 2019 - "Private Fire Service Mains and Their Appurtenances"
 - c. Requirements of local water department and local authority having jurisdiction over fire protection.
 - d. Applicable rules, regulations, laws, and ordinances.
 2. Comply with backflow prevention requirements and if required, include device in hydraulic calculations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved by the State Fire Marshal and the Architect, and in accordance with Division 01 requirements.
- B. All products shall be UL listed or FM approved for Fire Protection service unless specifically

allowed otherwise by this specification.

- C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- D. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

2.2 COMPONENTS

- A. Pipe
 - 1. Above Grade: Schedule 10, ASTM A135, Type E, Grade A and Schedule 40, ASTM A795, Type E, Grade A steel fire sprinkler pipe, FM approved, UL and FM listed, meeting NFPA 13 standards. Wheatland Tube or equal.
 - a. 2" and smaller: Welded, threaded, flanged, soldered, or roll grooved coupling system.
 - b. 2-1/2" and larger: Welded, flanged, or roll grooved coupling system.
 - 2. Below Grade: Cast iron, hub or mechanical joint. Install thrust blocks at all fittings.
 - 3. Piping and fittings used for the installation of underground water mains shall be listed for such service.
- B. Fittings
 - 1. Screwed: Cast/Ductile iron meeting requirements of ANSI B 16.4, Anvil, Victaulic or approved equal.
 - 2. Flanged: Cast/Ductile iron meeting requirements of ANSI B 16.1. Anvil, Victaulic or approved equal.
 - 3. Welded: Carbon steel meeting requirements of ASTM A 234.
- C. Roll grooved pipe coupling system. Victaulic Firelock system or approved equal.
 - 1. Couplings: Two ductile iron housing segments meeting the requirements of ASTM A536, pressure responsive elastomer gasket, and ASTM A449 compliant bolts and nuts.
 - a. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.). Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
 - b. Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
 - c. Installation-Ready™ fittings for Schedule 10 grooved end steel piping in fire protection applications sizes NPS 1-1/4 thru 2 1/2 (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends. Fittings complete with prelubricated Grade "E" EPDM Type 'A' gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
- D. Flexible Sprinkler Hose Fittings: Victaulic Vic-Flex with captured coupling, Flexhead Industries, or approved equal.
- E. Risers (in-Building)
 - 1. Ames Fire & Waterworks, series IBR or equal, type 304 stainless steel, 6'x6' standard length; UL/FM approved, meets NFPA 24; AWWA C900 inlet/DIP; AWWA C606 outlet. Includes test cap and coupler.
- F. Valves
 - 1. Butterfly Valves
 - a. UL / FM approved to 300 psi (2065 kPa).

- b. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - c. Pressure responsive elastomer seat.
 - d. Grooved end, with weatherproof actuator, handwheel, and supervisory tamper switches; Victaulic Series 705, Tyco BFV, or approved equal
 2. Globe Valves
 - a. UL / FM approved
 - b. WWP Bronze, threaded ends, screw over bonnet; Nibco KT-65-UL or approved equal
 3. Gate Valves
 - a. UL / FM approved.
 - b. Outside Screw and Yoke Type (OS&Y) 250 psi (1725-kPa), grooved ends, Victaulic Series 771; Class 150 psi, flanged ends.; Nibco F-637-31, Mueller A-2073-6, or approved equal
 4. Ball Valves
 - a. UL / FM approved, valve tamper switch
 - b. Threaded ends: Nibco KT-505, Milwaukee BBSC, or approved equal
 - c. Grooved ends: Victaulic Series 728, Nibco: KG-505, or approved equal.
 5. Check Valves
 - a. UL / FM approved
 - b. Spring-assisted for vertical or horizontal installation.
 - c. 2" - 12", Victaulic Series 717, Tyco Model CV-1F or approved equal
- G. Sprinklers: Pendent and Concealed Pendent, Horizontal Sidewall, Upright and Conventional:
 1. Tyco, Series TY-FRB - 5.6 K-factor Horizontal and Vertical Sidewall Sprinklers, Quick Response, Standard Coverage
 2. Tyco, Series TY-FRB - 2.8, 4.2, 5.6 & 8.0 K-factor Upright, Pendent, and Recessed Pendent Sprinklers, Quick Response, Standard Coverage
- H. Sprinkler Box:
 1. Tyco TFP 7856
- I. Pressure Gauges:
 1. Mechanical water pressure gauges:
 - a. UL / FM approved
 - b. 0 to 300 psi, Viking WATERSF, Reliable, Terrice or approved equal.
- J. Post Indicator - See Civil Drawings
- K. Fire Department Connection - See Civil Drawings.
 1. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage. Basis of Design: Victaulic #10-DR.
- L. Hangers and Supports
 1. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer. All hangers and supports shall be manufactured by Tolco Hanger Company or approved equal.
- M. Test and Drain Valves
 1. UL/FM approved, single handle, tamper resistant, with UL/FM pressure relief valve
 2. Victaulic Style 720 TestMaster II, or AGF Manufacturing, model 1011A TestanDrain, 300 psi bronze globe or ball valves, or engineer approved equal. The valve shall include a

tamper resistant test orifice and integral tamper resistant sight glasses, a tapped and plugged port for system access and steel identification plate.

N. Waterflow Detectors

1. System Sensor "WFDN" series vane-type waterflow detectors, or approved equal. The waterflow detector shall be listed to UL 346. The detector shall be installed on system piping as designated on the Drawings and/or as specified. Detectors shall mount on any clear pipe span of the appropriate nominal size, either a vertical upflow or horizontal run, at least 6 inches from any fittings that may change water direction, flow rate, or pipe diameter or no closer than 24 inches from a valve or drain.
2. Detectors shall have a sensitivity in the range of 4 to 10 gallons per minute and a static pressure rating of 450 psi for 2-inch – 8-inch pipes. The detector shall respond to waterflow in the specified direction after a preset time delay between 0 and 90 seconds that is field adjustable. The delay mechanism shall be a sealed mechanical pneumatic unit with visual and audible indication of actuation. The actuation mechanism shall include an ethylene vinyl acetate vane inserted through a hole in the pipe and connected by a mechanical linkage to the delay mechanism.
3. Outputs shall consist of dual SPDT switches (Form C contacts). Two conduit entrances for standard fittings of commonly used electrical conduit shall be provided on the detectors. A grounding provision shall be provided. Unless noted, enclosures shall be NEMA 4 listed by Underwriters Laboratories Inc. All detectors shall be listed by Underwriters Laboratories Inc. for indoor or outdoor use.

2.3 MISCELLANEOUS

- A. Provide all necessary escutcheons, drains, test valves and accessories, hose connections for flow test, spare parts, tools and signs that are required for the work of this Section.
- B. Provide signage to read, "Sprinkler Fire Alarm – When Alarm sounds, call 911/Fire Department". SafetySign.com #SPR-15 or equal.
- C. Provide General Information sign at each system control riser, antifreeze loop and auxiliary system control valve, per NFPA 13.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Drawings
 1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. Plumbing drainage piping and ductwork shall have the right of way over fire protection piping except for fire protection drainage piping wherever conflicts exist. Fire protection piping shall be offset or rerouted as directed at no additional cost to the Owner. These Drawings take precedence over Fire Protection Drawings.
 3. Because of the small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

3.2 INSTALLATION

- A. Follow general piping installation requirements specified in accordance with NFPA 13.

- B. Grooved joints shall be installed in accordance with the manufacturer's latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- C. Connect system to flange provided under Division 33.
- D. Install system to drain. Drain trapped piping in accordance with NFPA 13.
 - 1. Install main drain from riser.
 - 2. Install auxiliary drains in low points of piping system and inspector's test valve drain to mechanical pad located outside building unless otherwise directed by Architect.
- E. Install piping system so it will not be exposed to temperatures 40°F or lower.
- F. Do not use dropped, damaged, or used sprinkler heads.
- G. Install sprinkler lines above ceiling and within walls so that no piping is visible within the building. Where possible, pipes shall be concealed and run parallel to buildings lines.
- H. Install tamper switches and pressure flow detectors where located by Architect.
- I. Brace and support system to meet seismic zone requirements for building site.
- J. All concealed spaces shall be protected by sprinklers except areas not required by NFPA 13.
- K. Affix Underwriter's standard porcelain enameled identification signs to all fire protection sprinkler control valves, drain valves, and flow switches.

3.3 FIELD QUALITY CONTROL

- A. This Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Certificates of approval shall be furnished to the Owner. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at no expense to the Owner, make all repairs necessary to restore both his work and that of other contractors which may have been damaged to be in conformity with the Contract Documents.
- B. Site Tests
 - 1. Test system according to 'Contractor's Material And Testing certificate for Above Ground Piping NFPA 13.
 - 2. Tests shall be witnessed by Architect and representative of local jurisdiction over fire prevention.
 - 3. Test blanks shall have red painted lugs protruding beyond flange to clearly indicate their presence and be numbered to assure their removal when testing is completed.
- C. This Contractor shall make all tests required by all local, state, and federal laws, codes, ordinances, and regulations having jurisdiction over this work.

- D. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test result is obtained.
- E. At time of final inspection of the fire sprinkler system, the installing contractor shall provide to the school district:
 - 1. All literature and instructions provided by the manufacturer describing proper operation and maintenance of any equipment and devices installed,
 - 2. A copy of NFPA 25, 2013 California Edition and,
 - 3. A copy of CCR Title 19, Chapter 5 "Fire Extinguishing Systems".

3.4 SUPPLEMENTARY FIRE PROTECTION REQUIREMENTS

- A. Before bidding, be familiar with rulings of governing authorities and comply with such requirements.
- B. Protect unattended openings in piping from dirt and vandalism during construction.
- C. Ensure that joints do not occur in piping installed in pipe sleeves.
- D. Where construction is not inherently accessible, provide adequately sized and conveniently located access doors in ceilings, walls and furring for servicing valves, equipment, etc. Doors shall be delivered to the General Contractor for installation. Doors shall be Milcor, Zurn, or as specified under Division 08 Sections.
 - 1. Plaster surfaces: Style K
 - 2. Acoustic tile, gypsum board and tackboard surfaces: Style A
 - 3. Masonry surfaces: Style M
 - 4. Rated ceiling and walls: Style "Fire Rated".
- E. Pipe penetrations at finished surfaces shall be covered with chrome plated escutcheon plates with set screws.
- F. Install materials and equipment to allow convenient servicing (e.g., no piping in front of manholes, heaters, controls, electrical equipment, pumps, etc.).
- G. Where pipes, etc., pass through roofs or outside wall above grade, provide flashings with weather-tight installation. Where not otherwise specified or shown, flashings shall be 24-gauge minimum thickness galvanized steel, with 8" minimum flange all around and 8" minimum height.
- H. Sprinkler heads shall be located in center of ceiling tile.
- I. Exposed sprinkler pipe in stairways shall be bent to suit overhead contours (no offset fittings shall be used for this purpose).
- J. Connections from branches or mains to sprinkler heads shall be off of the top of branch or main pipe with return bend or piping for adjustment of location.
- K. All exterior walkways between and adjacent to the buildings shall be sprinkled.

3.5 OWNER'S INSTRUCTIONS

- A. Instruct building maintenance personnel in operation and maintenance of system, utilizing Operation and Maintenance manual when so doing. Minimum instruction period shall be 4 hours.

- B. Instruction periods shall occur after Substantial Completion inspection, when system is properly working, and before final payment is made.

3.6 MAINTENANCE

- A. Furnish valve wrenches and operating and maintenance instructions to Owner upon completion of work.
- B. Furnish twelve spare heads of each type and temperature rating used, properly boxed with sprinkler head wrench.

3.7 MICROBIOLOGICALLY INFLUENCED CORROSION (M.I.C.)

- A. All water used to charge or test the fire sprinkler system shall be treated to prevent M.I.C. in accordance with NFPA-13, 2019.
- B. Alternately, piping coated with "MIC Shield" (Wheatland Tube) may be used in lieu of treatment, if acceptable to the local and state Fire Marshal.

END OF SECTION

SECTION 22 0000

PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Furnishing, fabrication, and installation of complete Plumbing systems as shown on Drawings and as specified herein. Plumbing work includes, but is not necessarily limited to, the following items of work:
1. A complete system of soil, waste, vent and sanitary sewer piping and structures, including provisions for mechanical equipment drainage; and connection of same to site sanitary sewers, located as indicated on the Drawings.
 2. All plumbing fixtures and trim as scheduled on the Drawings, inclusive of setting of fixtures and connections to drainage and water supply systems.
 3. Hot water distribution system, complete, from new water heaters and/or points of contact with site domestic hot water, to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.
 4. Cold water distribution system, complete, from points of contact with site domestic water systems, located approximately as indicated on the Drawings, to all plumbing fixtures, mechanical equipment, building specialties, and Owner supplied equipment scheduled for service on the Drawings.
 5. Natural gas piping system, complete from utility company meters (located approximately as indicated on the Drawings) and terminating in stopcocks adjacent to natural gas fired equipment, as noted on the Drawings. All gas-fired equipment shall be equipped with a gas pressure regulator as hereinafter specified.
 6. Flashing of all plumbing pipe penetrations through exterior walls, roofs, and foundations. Sheet metal and lead flashings for pipe penetrations through roofs shall be furnished by the Plumbing Contractor and installed by the appropriate Roofing Contractor.
 7. Rough in and connection of all fixtures and equipment.
 8. Pipe wrapping and insulation.
 9. Final connection of water and gas to equipment furnished under other Sections.
 10. Storm water drainage systems within the building, inclusive of roof drains and copper, steel, or cast-iron storm water leaders, to points of contact with site drainage system.
 11. Condensate drainage piping and connections from points of attachment to equipment to indirect waste locations.
 12. Excavation and backfill as required for the work of this Section in conformity with Division 31 of the Specifications.
 13. Testing and adjusting of all piping systems and equipment herein specified.
 14. Sterilization of domestic water systems.
- B. All work shall be coordinated with water, gas, sanitary sewer, and other services on the site. The locations of points of connection to the site services shall be confirmed prior to commencement of any and all work required under this Section of the Specifications.
- C. The Contractor shall furnish all materials and labor under the scope of the Contract, unless otherwise noted. Anything accepted as standard trade practice reasonably incidental to the completion of the plumbing systems shall be furnished without additional cost to the Owner. The Contractor shall understand that the work herein described shall be complete in every detail, notwithstanding every item necessarily involved is not particularly mentioned, and the Contractor shall be held to provide all labor and material necessary for the entire completion of the work.
- D. Related Sections

1. Section 07 6200 for sheet metal flashing and trim;
2. Section 07 9200 for joint sealants;
3. Section 07 8400 for firestopping;
4. Section 26 0500 for basic electrical materials & methods;
5. Section 09 9000 for painting requirements;
6. Section 32 8100 for water service, meter, and piping in connection with landscape irrigation system;
7. Section 31 2000 for earthwork and grading;
8. Section 31 2333 for trenching and backfilling;
9. Section 23 0000 HVAC.

1.2 QUALITY ASSURANCE

- A. Regulatory compliance: All work performed under this Section shall comply with the latest currently adopted editions of all codes and regulations and all requirements of all Authorities having Jurisdiction.
- B. Codes and Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:
 1. American Gas Association (AGA)
 2. American National Standards Institute (ANSI)
 3. Adhesive and Sealant Council (ASC)
 4. American Society of Mechanical Engineers (ASME)
 5. American Society for Testing and Materials (ASTM)
 6. American Society of Civil Engineers (ASCE)
 7. California Building Code (CBC)
 8. California Plumbing Code (CPC)
 9. California Fire Code (CFC)
 10. California Energy Conservation Code, Title 24
 11. State of California Administrative Code (CAC) Titles 8, 17, and 24
 12. California Electric Code (CEC)
 13. National Electrical Manufacturers Association (NEMA)
 14. National Fire Protection Agency (NFPA)
 15. Underwriters' Laboratories (UL)
 16. Comply with all ADA and California Title 24 requirements for disabled access.
 17. City Fire Marshal requirements
 18. Comply with the latest edition of all applicable standards, including AWWA, PDI, and OSHA
 19. NSF/ANSI 61 Standard, *Drinking Water System Components - Health Effects* for fixture materials that will be in contact with potable water.
 20. AB 1953, Amendments to Section 116875 of the Health and Safety Code relating to lead plumbing.
- C. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.
- D. When the Contract Documents call for materials or construction of a higher standard than is required by the above, the Contract Document requirements shall take precedence over the requirements of the said laws, rules, and/or regulations, accepting that nothing in the Contract Documents shall be interpreted as permitting work in violation of said laws, rules, and/or regulations. The Contractor for this work shall furnish any additional materials and/or labor as may be required for compliance with these laws, rules, and/or regulations though such materials and/or labor are not specifically set forth in the Contract Documents, with no additional charges to Owner.

- E. Seismic construction and restraints shall be in accordance with the requirements of the California Building Code and Title 17 and Title 24 of the California Code of Regulations. All equipment mounts, isolators, and hanging systems must meet DSA approval requirements.
- F. Comply with the Safety Orders issued by Cal-OSHA and any other regulations of the State of California and any districts having jurisdictional authority.

1.3 SUBMITTALS

- A. All submittals shall be submitted under the provisions of Division 01 and the following.
- B. Product Data: For each type of product.
 - 1. Submit cut sheets for each plumbing fixture. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow control rates for each fixture indicated.
 - 2. Submit manufacturer's product data for all plumbing piping, fittings, materials, and equipment.
- C. Shop Drawings:
 - 1. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2012 or newer and shall be drawn at a minimum $\frac{1}{4}'' = 1' - 0''$ scale. Sections, details, and diagrams shall be to required scales for specified areas.
 - 2. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until layout drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor's expense.
 - 3. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase indicating all equipment and trades' work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing.
 - 4. Use of contract documents for shop drawings is not acceptable
- D. Welding Procedure
 - 1. Before any welding is performed, the contractor shall submit to the Architect, copies of any welding procedure specifications and their supporting procedure qualification records for review and acceptance. Copies of welder qualification records shall be made available for review to the owner or his representative at the construction site.
 - 2. Welding certificates.
- E. As-Built Drawings
 - 1. A complete set of Contract Drawings shall be maintained at the work site, and all changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:
 - a. Exact location, type and function of concealed valves and controllers.
 - b. Exact size, elevations and location of underground and under floor piping.
 - 2. Submit to Architect for approval.
- F. Operation & Maintenance Data
 - 1. Contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment,

- and operation of each piece of apparatus, including preventative maintenance schedule and procedures.
2. Contractor shall also provide a parts list of all equipment and component parts for all equipment under this Section. The equipment list shall include manufacturer's name, model number, and local representative, service facilities and normal channel of supply for each item.
 3. Also include the following:
 - a. Manufacturer's certified shop drawings, and lubrication charts and data. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.
 - b. Description of start-up and operating procedures for each system. including controls diagrams and description of operating sequences.
 - c. Recommend preventative maintenance schedule and procedures.
 4. Submit data to the Architect for approval.
- G. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.
- H. Warranties
1. Warranty all materials, equipment, apparatus and workmanship to be free from defects and faulty workmanship for a period of one year from date of filing Notice of Completion. Furnish Manufacturer's standard Warranties in excess of one year.
 2. Provide new materials, equipment, apparatus and labor to replace that determined to be defective or faulty.

1.4 ACCURACY OF DATA

- A. The data given herein and on the Drawings are as exact as could be reasonably secured, but absolute accuracy is not guaranteed. Exact locations, distances, elevations, etc. will be governed by shop drawings, the building itself, and actual field conditions.

1.5 UTILITY CONNECTIONS

- A. Provide all services within the building to a point five feet outside of building. Arrange for all utility connections, determine their exact requirements, and pay all costs incurred.
- B. Send proper notices, make necessary arrangements, and perform other services required for care and maintenance of all utilities and assume all responsibility concerning same. Observe all rules and regulations of the respective utilities in executing the work.

1.6 DAMAGE BY LEAKS

- A. Contractor shall be responsible for any damage to work of other Contractors that is caused by leaks in any temporary or permanent piping systems due to pipe rupture, disconnected pipes or fittings, or by overflow of equipment.

1.7 COORDINATION

- A. All work shall be coordinated with water, gas, sanitary sewer, and other services on the site. The locations of points of connection to the site services shall be confirmed prior to commencement of any and all work required under this Section of the Specifications.
- B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with original design and referenced standards.

1.8 COOPERATION WITH OTHER TRADES

- A. Cooperate fully with other trades doing work on the project as may be necessary for the proper completion of the project. Refer to the Structural, Plumbing, and Electrical Drawings for details of the building structure and equipment installation that will tend to overlap, conflict with, or require coordination with the work of this Section, and schedule this work accordingly.
- B. Priority of right of way in space shall be as follows, in decreasing order of authority:
 - 1. Electrical lights, electrical panels and drain piping.
 - 2. Ductwork.
 - 3. Fire protection piping, domestic hot water, domestic cold water and condenser water piping.
- C. Any work done without regard for other trades shall be moved, replaced, or redone as required, without extra charges to Owner.

1.9 LICENSING REQUIREMENTS

- A. All plumbing systems shall be installed by a C-36 Plumbing Contractor. Plumbing systems include: waste removal and connection of on-site waste disposal systems; piping, storage tanks, and venting for supply of gases and liquids for any purpose; all gas appliances, flues, and gas connections; water and gas piping from the owner's side of utility meter to the structure or fixed works; installation of any type of equipment to heat water or fluids to a suitable temperature; and maintenance and replacement of the items described above, including health and safety devices.

PART 2 - - PRODUCTS

2.1 PRODUCTS CRITERIA

- A. Only specified materials shall be utilized in the work of this Section unless substitutions have been approved in accordance with the General Conditions and Division 01 Sections of these Specifications.
- B. All materials, appliances, and equipment shall be new and best of their respective kinds, free from defects, and of the latest design.
- C. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- D. Apply and install all items in accordance with the manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Architect for resolution.
- E. All fixtures, materials, and equipment equal in quality and utility to these herein mentioned will be accepted. When specific names are used in describing fixtures, materials, and equipment they are mentioned as standards only, but this implies no right on the part of the Contractor to use other fixtures, materials and equipment, or methods, unless approved as equal in quality and utility by the Architect. The decision of the Architect shall govern as to what fixtures, materials, and equipment are equals to those mentioned, but the burden of proof as to the quality of any proposed fixtures, materials, or equipment shall be upon the Contractor. If any tests are necessary to determine the quality of proposed fixtures, materials, or equipment, an unbiased laboratory that is satisfactory to the Architect shall make such tests, at the expense of the Contractor.

2.2 PIPE, FITTINGS

A. General

1. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
2. Manufactured materials delivered, new to the project site and stored in their original containers.
3. Product Marking:
 - a. Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.
4. Tracer wire shall be installed with all non-metallic piping below grade. Tracer wire shall be solid core copper, 14-gauge minimum, laid continuously along pipes. Wire shall be "ty-wrapped" to pipe at 8 feet on center. Tracer wire shall terminate in concrete access boxes at the beginning and terminal ends of the buried pipe.
5. All accessible pipe 2" and smaller shall be threaded. Fittings for threaded pipe shall be 150-lb. malleable iron, screwed and banded.
6. Vent piping shall have vandal resistant mushroom vent caps.
7. At penetrations through building walls, provide "Link Seal" around pipe.

B. Below Grade Soil, Waste, Drain and Vent Piping:

1. Below grade piping shall be of standard weight, no-hub cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301 and ASTM A 888 (latest editions). All pipe and fittings shall be manufactured in the United States and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute® and listed by NSF® International. Approved manufacturers: AB&I, Charlotte and Tyler Pipe or approved equal.
2. Joints for hubless pipe and fittings conform to the manufacturer's installation instructions and local code requirements.
3. Hubless couplings shall be composed of stainless-steel shields, clamp assemblies and elastomeric sealing sleeve conforming to CISPI Standard 310, latest edition. Heavy/Medium duty no-hub couplings shall conform to the requirements of ASTM 1540. Hubless coupling gaskets shall conform to ASTM C564. Couplings 1-1/2" through 4" shall have 4 bands.
 - a. Piping 2" and smaller: Heavy/Medium duty no-hub couplings. Anaco/Husky "HD 2000", Ideal-Tridon Heavy Duty "HD", Charlotte Heavy Duty "MD" or Mission "Heavyweight or approved equal. .
 - b. Piping 2 1/2" or larger: Heavy/Super Duty type: Husky SD 4000 or Clamp-All Hi-Torq 125.
 - c. Couplings shall be installed in accordance with manufacturer's installation instructions and local code requirements and shall be tightened using a calibrated torque wrench. The clamps shall be tightened between 115 and 125-inch pounds.

C. Above Grade Soil, Waste, Drain, and Vent Pipe:

1. Above grade piping shall be of standard weight, no-hub cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301 and ASTM A 888 (latest editions). All pipe and fittings shall be manufactured in the United States and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute® and listed by NSF® International. Approved manufacturers: AB&I, Charlotte and Tyler Pipe.
2. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions and local code requirements. Hubless couplings shall be composed of stainless steel shields, clamp assemblies and elastomeric sealing sleeve conforming to CISPI Standard 310, latest edition. Heavy/Medium duty no-hub couplings shall conform to

the requirements of ASTM 1540. Hubless coupling gaskets shall conform to ASTM C564. Couplings 1-1/2" through 4" shall have 4 bands.

- a. Piping 2" and smaller: Heavy/Medium duty no-hub couplings. Anaco/Husky "HD 2000", Ideal-Tridon Heavy Duty "HD", Charlotte Heavy Duty "MD" or Mission "Heavyweight" or approved equal.
 - b. Piping 2½" and larger: Heavy/Super duty no-hub couplings. Anaco/Husky 4000 or Clamp-All Hi-Torq 125.
 - c. Couplings shall be installed in accordance with manufacturer's installation instructions and local code requirements. The clamps shall be tightened using a calibrated torque wrench
3. At the option of this Contractor, all soil, waste, and vent piping above ground may be DWV copper, with wrought copper fittings, with lead free solder and a suitable non-corrosive flux.
- D. Hot, Cold & Tempered Water Piping:
1. All domestic hot, cold and tempered water piping 3" and smaller shall be Type L, hard temper copper pipe, ASTM B88, with wrought copper or cast brass solder joint fittings. Pipe shall be NSF 61 Certified and bear the NSF Certification mark. Mueller Streamline, Cerro Flow, or approved equal.
 2. All joints shall be made up with lead free solder. A suitable non-corrosive flux shall be used at all joints.
 3. Mechanical press fittings shall also be acceptable for piping 2" and smaller:
 - a. Viega "Copper Press" or Nibco "Press System" fittings or approved equal. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path).
- E. Condensate drainage piping: Mueller Streamline, Cerro Flow, or approved equal.
1. Type M, hard temper copper, ASTM B 88
 - a. Drainage fittings shall be ASME B16.29, wrought copper
 - b. Solder shall be ASTM B32, Alloy Grade Sn50 with ASTM B813, water-flushable flux.
- F. Lead Free Solder and Flux:
1. Solder: ASTM B32. Harris "Staysafe Bridgit", Lucas Milhaupt "Silvabrite 100", or equal.
 2. Flux: ASTM B813. Oatey Jet Flux, LA-CO Regular Soldering Flux, or d equal.

2.3 UNIONS

- A. Unions or flanges shall be furnished and installed at each threaded connection to all equipment or valves. The unions shall be located so that the piping can be easily disconnected for removal of the equipment, tank, or valve, and shall be of the type specified in the following:
1. Copper pipe unions shall be Class 150 bronze unions with soldered joints. Nibco series B25860L, equivalent Mueller, or approved equal.
 2. Ferrous pipe unions shall be malleable iron, threaded.

2.4 DIELECTRIC FITTINGS

- A. Precision Plumbing Products, "Clear Flow" series or approved equal, threaded dielectric fittings, sizes 19100P thru 19195P.
- B. Dielectric fittings shall have zinc electroplated steel casing, and NSF/FDA listed lining. Fittings shall meet the requirements of ASTM standard F1545 for continuous use at temperatures up to 225°F (- +5°F) and for pressures up to 300 psi and shall achieve a dielectric waterway in all potable water applications.

2.5 VALVES, SPECIALTIES

A. General Requirements

1. All valves, except pressure reducing and control valves, shall be the same size as the pipe to which they are installed.
2. All valves of a particular type and size range shall be the product of one manufacturer.
3. Valve body materials shall be compatible with piping system materials.
4. Provide a union immediately downstream from each valve, unless the valve is flanged.
5. All valves shall be installed with the stem 45° above horizontal, if possible. In no case shall the stem be installed below horizontal.
6. Where insulation is indicated, install extended stem valves arranged in proper manner to receive insulation.
7. Manufacturer's name (or trademark) and pressure rating shall be clearly marked on valve body.
8. Valve end connections: Solder joint with sockets per ASME B16.18; Threaded with thread per ASME B1.20.1.

B. Ball Valves

1. 2 ½" and smaller: 2-piece full port; bronze body; lead free brass ball and blowout proof stem; RPTFE packing and seat; zinc plated steel handle. Extended soldered ends for copper pipe and threaded ends for iron pipe. MSS SP-110; 400 - 600 psi CWP. Apollo 77CLF-A series or equivalent Clow, Kennedy, Nibco or approved equal.

C. Gate Valves

1. 2" and smaller: Class 150, MSS SP-80, ASTM B62 cast bronze body, bonnet, wedge, non-rising stem, non-asbestos packing and malleable iron hand-wheel. Apollo 106T series or approved equal.

D. Swing Check Valves

1. 2" and smaller: Class 125, bronze body, horizontal swing, regrinding, Y-pattern, renewable disk. Nibco T-413-Y-LF or approved equal.

E. Backflow Preventers (where shown on Drawings or required by local code)

1. Low Hazard Applications: Double Check Valve Assembly (DCVA)
 - a. 2" and smaller:
 - 1) Febco #850-650A
 - 2) Conbraco Apollo #40-110-T2
 - 3) Watts #007-QT-FDA-S
 - 4) Wilkins #350-S-XL
 - 5) Or approved equal.
2. Atmospheric Vacuum Breakers:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equal.

F. Water Pressure Regulating Valves:

1. Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless-steel strainer
 - a. Zurn Wilkins 500XLYSBR series
 - b. Cash Acme
 - c. Cla-Val
 - d. Watts
 - e. Or approved equal
2. Install where pressure to building exceeds 70 psi.

2.6 HOSE BIBBS

- A. HB-2 (Exterior Hose Bibb) Wall hydrant, Zurn Z1320-CXL or equivalent Chicago, Jay R Smith, Mifab, Wade, Woodford, or approved equal. Encased, "Ecolotrol" non-freeze automatic wall hydrant for flush installation. Hydrant shall have integral backflow preventer with anti-siphon technology, copper casing, bronze and stainless-steel interior components, non-turning operating rod with free-floating compression closure valve, combination 3/4" female solder and 3/4" male pipe thread inlet connection, and 3/4" male hose connection. Hydrant shall be furnished with chrome plated rough cast bronze housing with locking hinged cover stamped "WATER" and shall include operating key.
1. Note: After the hydrant box has been properly set, additional caulking of all inside joints is required, including the seams where gasket is present.

2.7 WALL AND FLOOR SLEEVES

- A. Pre-engineered firestop pipe penetration systems: UL listed assemblies for maintaining fire rating of piping penetrations. Installation shall be in full accordance with the requirements of the UL system number. ASTM E814
1. HOLDRIGHT HydroFlame
 2. Proset
 3. Or approved equal
- B. Below grade and high water table areas:
1. Modular link sealing system at pipe sleeves: Neoprene gaskets bolted together around an interior sleeve forming a watertight seal. Use at sleeves to continuously fill the annular space between the pipe and wall opening.
 - a. GPT Industries "Model C Link-Seal" modular seal
 2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6" beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high-water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.
- C. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814. Hilti, Proset or approved equal.
- D. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.
- E. Fabricated Accessories:
1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
 - a. Sleeve Size 4" in diameter and smaller: 18 gauge.
 - b. Fire-Rated Safing Material:
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985⁰ F and K value of 0.24 at 75⁰ F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100⁰ F to 1200⁰ F service with K value of 0.40 at 150⁰ F.
- F. Flashing
1. Steel Flashing: 26-gauge galvanized steel.
 2. Safes: 8 mil thick neoprene.
 3. Caps: Steel, 22-gauge minimum, 16-gauge at fire-resistant structures.

4. Provide hot dipped galvanized components for items exposed to weather.
 - a. Fastenal
 - b. Or approved equal

- G. Miscellaneous Metal and Materials: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
 2. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
 3. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
 4. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
 5. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
 6. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.
 7. Provide hot dipped galvanized components for items exposed to weather. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.

- H. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Non-staining, noncorrosive, and non-gaseous.
 - a. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.8 FLOOR DRAINS

- A. FD-2: Zurn Z1187-SI or approved equal sand interceptor; fabricated steel with acid resistant coating, threaded inlet and outlet, removable heavy-duty grate.

2.9 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.

- B. Cleanouts in membrane dampproofed floors shall have flashing flange and membrane clamps. Plugs shall be bronze, with cast iron body ferrule for cast iron pipe.
 1. Floor Cleanouts (FCO): Jay R. Smith 4020 series with round or square heavy-duty nickel bronze top, taper thread, ABS plug and standard screws or vandal-proof screws.
 2. Grade (COTG): Zurn Z-1474-N with internal cleanout or equal Jay R Smith. Cleanout housing to be dura-coated cast iron body with integral anchor flange and scoriated cover with lifting device. Cleanouts in un-paved areas shall be set in 18" x 18" x 6" concrete pads.

3. Wall Cleanouts (WCO): Jay R. Smith 4020-U with round heavy-duty nickel bronze top, taper thread, ABS plug and top secured with vandal-proof screws. Install in 18" x 18" x 6" deep concrete pad flush with grade.

2.10 SHOCK ABSORBERS

- A. Zurn Z1700 "Shoktrol" water hammer arrestors, stainless steel bellows, or Jay R Smith "Hydrotrol" series. Install with gate valve shut-off and access door at all flush valves or other automatic valves. A single unit sized in accordance with the manufacturer's recommendations may serve batteries of valves.

2.11 TRAP PRIMERS

- A. Trap primers shall be installed for all floor drains as follows:
 1. Trap primers shall be Precision Plumbing Products (model P2-500 or PR-500) or approved equal. Trap Primers shall be pressure drop activated and be of all brass construction including a brass body with 1/2" male NPS inlet and 1/2" female NPT discharge. Internal components shall consist of a stainless-steel debris screen, brass piston and brass discharge jet. Lubricated O-rings shall be EPDM and seal O-rings shall be nitrile.
 2. Trap primers shall be installed on fresh cold-water lines of 1 1/2" diameter or less and shall be located where they will be subjected to frequent pressure drops of at least 10 psi. Install with shut off valve and access doors in Janitor's closets, Mechanical Rooms and other areas not served by, or in close proximity to, flushometer valve operated water closets.
 3. Working pressure shall be 20 to 80 psig.

2.12 ACCESS PANELS

- A. Where construction is not inherently accessible, provide adequately sized and conveniently located access doors in ceilings, walls, and furring for access to controls and for servicing valves, equipment, etc.
 1. Fire Rated walls and ceilings: Milcor, Style UFR, or approved equal, U.L. Class B, 1 1/2 hour rating, insulated, self-closing, self-latching, flush key operated cylinder lock, interior latch release. Minimum size shall be 12" x 12". Provide larger sizes where required.
 2. Drywall ceilings or walls: Milcor, Style DW, or approved equal, prime coated steel, flush screwdriver-operated cam lock. Minimum size shall be 12" x 12". Provide larger sizes where required.
 3. Masonry walls and tiled walls: Milcor, Style M, or approved equal, prime coated steel, flush screwdriver-operated cam lock; satin finish at tiled walls. Minimum size shall be 12" x 12". Provide larger sizes where required.
 4. Plastered walls and ceilings: Milcor, Style K, or approved equal, prime coated steel, flush screwdriver-operated cam lock. Minimum size shall be 12" x 12". Provide larger sizes where required.
- B. Doors shall be delivered to the General Contractor for installation.

2.13 THERMOMETERS

- A. Weksler "Adjust-Angle", equivalent Weiss, or approved equal, with separable sockets and 6" minimum scale reading 30°F-240°F.

2.14 PIPE INSULATION

- A. General

1. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
2. Insulation materials shall be formaldehyde free, a minimum of 40% post-consumer recycled glass content certified and UL validated.
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

B. Glass Wool Pipe Insulation

1. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
 - a. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf°F) at 75⁰ F.
 - b. Maximum Service Temperature: 850⁰ F to 1000⁰ F.
 - c. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.
2. Manufacturers: Owens-Corning, Johns Manville, or approved equal.

C. Flexible Elastomeric Insulation

1. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - a. Thermal Conductivity Value: 0.25 BTU*in/(hr*sf°F) at 75⁰ F.
 - b. Maximum Service Temperature of 220⁰ F.
 - c. Maximum Flame Spread: 25.
 - d. Maximum Smoke Developed: 50 (3/4" thick and below).
 - e. Connection: Waterproof vapor retarder adhesive as needed.
 - f. UV Protection: UV outdoor protective coating per manufacturer's requirements.
2. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
3. Manufacturers: Armacell LLC Armaflex, K-Flex, or approved equal.

D. ADA Accessible Lavatory/Sink Insulation Kit

1. P-traps, trap arms, tail pieces, hot water and cold-water insulating guards. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Thermal conductivity; K = 1.17 (BTU*in/(hr*sf°F) at 75⁰ F mean temperature. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color: white.
2. Manufacturers: IPS/Truebro "LavGuard2", McGuire Mfg. "ProWrap", Plumberex "Pro-Extreme" or approved equal.

E. Jacketing

1. Aluminum Jacket: 0.016" thick sheet, smooth or embossed finish, with longitudinal slip joints and 2" laps, die-shaped fitting covers with factory attached protective liner. ASTM B 209, ASTM 1729, C1371.
2. Stainless Steel Jacket: Type 304 stainless steel, 0.010", smooth or corrugated finish. ASTM A 666
3. Manufacturers: Johns Manville or approved equal.

F. Pipe Fitting Insulation Covers

1. PVC Plastic Fitting Covers: One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.
2. Manufacturers: Johns Manville "Zeston 2000", Knauf "Proto Fitting" or approved equal.

G. Piping surfaces to be insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
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Hot Water Piping Above Grade (105°F to 140°F)	Glass Wool	Runouts up to 1-1/2" (uncirculated branches) Mains =<1 1/4" Mains >1 1/4"	1" 1" 1 1/2"
Hot Water Circulation Piping Above Grade (105°F to 140°F)	Glass Wool	Runouts up to 1 1/2" Mains =<1 1/4" Mains >1 1/4"	1" 1" 1 1/2"
Cold Water Piping Above Grade	Glass Wool	=<1 1/2" >1 1/2"	1/2" 1"
Hot Water Piping Below Grade	Flexible Elastomeric Insulation	2 =<1 1/2" >1 1/2"	1" 1 1/2"
Hot Water Circulation Piping Below Grade	Flexible Elastomeric Insulation	2 =<1 1/2" >1 1/2"	1" 1 1/2"
Water Piping Exposed to Weather	Glass Wool or Flexible Elastomeric Insulation	All	1/2"
ADA Accessible Lavatory/Sink	Sink Insulation Kit	All	as listed
Condensate Drainage Piping	Glass Wool or Flexible Elastomeric Insulation	All	1/2"

2.15 VALVE BOXES

- A. Christy #B-09, or approved equal, complete with concrete cover and required extensions. Index all covers "WATER" as required for service use.

2.16 IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

- A. Brady, Seton, Brimar, or approved equal pipe labels. Preprinted plastic with contact-type, permanent-adhesive backing, color-coded, with lettering indicating service, and showing flow direction.
- B. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
- C. Label Sizes (per ANSI A13.1 / ASME A13.1-2015 Standards):
 - 1. For pipes or covering with outside diameter 3/4" to 1 1/4", minimum length of label: 8", minimum height of letters: 1/2".
 - 2. For pipes or covering with outside diameter 1 1/2" to 2", minimum length of label: 8", minimum height of letters: 3/4".
 - 3. For pipes or covering with outside diameter 2 1/2" to 6", minimum length of label: 12", minimum height of letters: 1 1/4".
- D. Pipe Label Color Schedule: (per ANSI A13.1 / ASME A13.1-2015)
 - 1. Potable, Cooling, Boiler Feed and other Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Fire Quenching Fluids:

- a. Background Color: Red.
 - b. Letter Color: White.
 3. Combustible Fluids:
 - a. Background Color: Brown.
 - b. Letter Color: White
 4. Toxic and Corrosive Fluids
 - a. Background Color: Orange.
 - b. Letter Color: Black
 5. Flammable Fluids:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
- E. Valve Tags: Brady, Brimer, Craftmark, Champion America, Seton, or approved equal.
 1. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1 ½" diameter.
 2. Metal Tags: Polished Brass with stamped letters; tag size minimum 1 ½" diameter with
 3. smooth edges.
 4. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
 5. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
 6. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
 7. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - a. Size: Approximately 4" x 7".
 - b. Fasteners: Brass grommet and wire.
- F. Plastic Nameplates: Brady or approved equal.
 1. Description: Engraving stock melamine plastic laminate 1/8" thick, engraved with engraver's standard letter style of the sizes and wording indicated.
 - a. Letter Color: White.
 - b. Letter Height: ½".
 - c. Background Color: Black.
 - d. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- G. Access Panel Markers: Brady, Brimer, Craftmark, Champion America, Seton or approved equal.
 1. Manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
- H. Signage for hot water outlets on 140°F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
 - a. Manufacturer's standard 1/8" thick engraved plastic laminate signage 4" x 4".
 - b. Letter Color: Red.
 - c. Letter Height: ½"
 - d. Background Color: White.
 - e. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- I. Detectable Underground Tape
 1. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape with aluminum backing, minimum 6" x 4 mil thick, manufactured for direct burial service.

- a. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.17 HANGERS AND SUPPORTS

- A. Manufacturers:
 1. Pipe hangers/supports: B-Line, Anvil, HOLDRITE "Snappitz" or approved equal
 2. Channel support systems: B-Line, Anvil "Anvit-Strut", Unistrut, HOLDRITE "EZ-Strut", or approved equal.
- B. Piping hangers and supports and hanger rod attachments shall be factory fabricated to suit piping systems in accordance with manufacturer's published product information.
 1. Use only one type by one manufacturer for each piping service.
 2. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
 3. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 4. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
 5. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5" and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
- C. Pipe Hangers, Guides and Channel Systems:
 1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
 2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 3. Pipe Rings for Hanger Rods: Pipe sizes 2" and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2 ½" and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
 4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32" minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16" minimum thickness; attachment to pipe and framing by welding.
 5. Pipe Guides:
 - a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
 6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8" square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring ½" size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
- A. Pipe Saddles and Shields:
 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12" in length (4" pipe and larger to be 3 times longer than pipe diameter).
- B. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength

insulation, encased in sheet metal shield.

1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
4. For Clevis or Band Hanger: Insert and shield to cover lower 180° of pipe.
5. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.
6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360° PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.

D. Hangers for Pipe Size 2" and Smaller:

1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.

E. Hangers for Pipe Size 2 ½" and Larger:

1. Adjustable clevis type, UL listed, Type 1.

F. Riser Clamps:

1. Steel, UL listed. MSS Type 8.

G. Flashing

1. Steel flashing: 26-gauge galvanized steel.
2. Provide hot dipped galvanized components for items exposed to weather.
3. Manufacturers: Fast

2.18 VIBRATION AND SOUND CONTROL

- A. Make all necessary provisions to prevent the transmission of vibration to the building structure and the passage of noise from the equipment rooms to other rooms. Provisions shall include vibration isolators for motor driven equipment; flexible pipe connections to motor driven equipment; resilient mounting for piping; sealing off pipe and duct penetrations of walls, floors and ceilings of equipment rooms.
- B. Make all necessary provisions to prevent the transmission of vibration to the building structure
- C. All piping which is not isolated from contact with the building by its insulation shall be installed with a manufactured type isolator. Isolators shall be B-Line "Vibra Clamp" and "Vibra Cushion", Super Strut, "Trisolator", or equal. Piping shall be installed and supported in a manner to provide for expansion without strains. Guides shall be properly installed to ensure this requirement.
- D. Provide pipe and sound isolation for all piping through walls, "Acoustoplumb" by LSP/Specialty Products, "Holdrite Silencer" by Hubbard Enterprises, or equal.

2.19 FIXTURES

- A. The quantity and location of fixtures shall be taken from the Architectural and Plumbing drawings. Provide adequate supports and all standard trim normally furnished for fixtures. All enamel shall be acid resisting. Traps, unless otherwise noted shall be 17 gage brass tubing, chrome plated when exposed.
- B. Submit catalog cut-sheets on all fixtures.

- C. Except as otherwise shown, provide ¼" steel backing plates, 36" wide by 12" high minimum size, secured to a minimum of three studs by welding, or with ¼" x 2½" lag screws for all wall hung fixtures for which no other means of support is specified.
- D. Stops and supplies: Provide stops for all fixtures. Unless otherwise specified, stops exposed at lavatories and similar fixtures shall be Chicago #1016ABCP, chrome plated, loose key. Concealed stops shall be Chicago #1771ABCP.
- E. All fixtures shall be standard white color, except as noted.
- F. All fixtures shall meet or exceed the requirements of the California Administrative Code, Title 24, Part 5.
- G. All plumbing fixtures providing domestic water shall comply with AB 1953, lead free. This includes, but is not limited to, lavatory faucets, sink faucets, shower valves, emergency showers, hose bibbs, and drinking fountains.
- H. All vitreous china fixtures shall be Kohler or equivalent American Standard or Zurn, except where specifically noted otherwise. All fixtures shall be standard white color, except as noted.

1. P-1 - WATER CLOSET

- a. Fixture: American Standard "Madera FloWise" #3451.001; floor mounted; elongated bowl; siphon jet flush; 15" high; 1.1 gpm
- b. Flush Valve: American Standard 6066.111.002; exposed, sensor operated; long-life battery pack (10 years) and fully mechanical override
1.1 gpf
- c. Seat: Olsonite #95SSCT or equal

2. P-1A - WATER CLOSET (ADA)

- a. Fixture: American Standard "Madera FloWise" #3461.001; floor mounted; elongated bowl; ADA compliant, 16 ½" height; siphon jet flush;
1.1 gpm
- b. Flush Valve: American Standard 6066.111.002; exposed, sensor operated; long-life battery pack (10 years) and fully mechanical override;
1.1 gpf
- c. Seat: Olsonite #95SSCT or equal

3. P-2 LAVATORY

- a. Fixture: American Standard "Lucerne" #0355.012; 20 1/2" x 18 1/4" vitreous china; front overflow, faucet ledge; 15" x 10" x 6 1/2" D-shaped bowl; 4" centers with extra right hand hole for soap dispenser (soap dispenser specified by Architect). (See Architectural Drawings for mounting height)
- b. Faucet: Sloan "Optima" #ETF-80-4-BOX-TEE-CP-0.35GPM-MLM-IR-BT-FCT; deck mounted; hard-wired; 4" trim plate, 24 VAC box transformer power supply, back-check tee, infrared sensor; 0.35 gpm; (HW/CW)
- c. Drain: McGuire #155A or equal; open grid PO plug
- d. P-Trap: McGuire #8902 or equal; insulated adjustable trap with cleanout;
- e. Carrier: Zurn Z-1231 or Jay R Smith Figure 0710, or equal

4. P-2A LAVATORY (ADA)

- a. Fixture: American Standard "Lucerne" #0355.012; 20 1/2" x 18 1/4" vitreous china; front overflow, faucet ledge; 15" x 10" x 6 1/2" D-shaped bowl; 4" centers with extra right hand hole for soap dispenser (soap

- dispenser specified by Architect) (See Architectural Drawings for ADA mounting height)
- b. Faucet: Sloan "Optima" #ETF-80-4-BOX-TEE-CP-0.35GPM-MLM-IR-BT-FCT; deck mounted; hard-wired; 4" trim plate, 24 VAC box transformer power supply, back-check tee, infrared sensor; 0.35 gpm; (HW/CW)
 - c. P-Trap: McGuire #PW2150WC or equal; insulated adjustable trap with cleanout; offset grid drain, includes covers for riser, angle stop, and tailpiece.
 - d. Carrier: Zurn Z-1251 or equal
5. P-4 –JANITOR SINK:
- a. Fixture: Kohler "Whitby" #K-6710 or approved equal.
 - b. Faucet: Chicago 897-CP or approved equal; vacuum breaker; pail hook; chrome plated; adjustable centers; 369 indexed lever handles. (HW/CW)
6. P-5A SINK (ADA)
- a. Fixture: Just SL-ADA-1921-A-GR or approved equal; single bowl; 19 X 21" X 4 ½" deep; 18 gauge type 304 stainless steel; 8" centers; drain location:
 - b. Faucet: Chicago Faucets #786-E65VPCABCP, concealed deck-mount with 8" fixed centers, chrome plated; 5 ¼" rigid/swing gooseneck spout; 1.0 GPM laminar flow non-aerating outlet. 4" metal wristblade handles; index buttons. "Quaturn"™ rebuildable compression cartridge(HW/CW)
 - c. Drain: Just J-ADA-35 or equal; chrome plated brass, offset tailpiece, removable basket
 - d. Solids Interceptor: Zurn Z1180 or approved equal, acid resistant composite interceptor, in lieu of fixture P-trap, for on floor installation, with removable PVC sediment bucket having removable 3/32" perforated flow defusing screen, top access gasketed secured cover, and ABS handle.
7. P-5B (ADA)
- a. Fixture: Just SL-ADA-1921-A-GR or approved equal; single bowl; 19" X 21" X 4 ½" deep; 18 gauge type 304 stainless steel; 8" centers
 - b. Faucet: Chicago Faucets #786-E65VPCABCP, concealed deck-mount with 8" fixed centers, chrome plated; 5 ¼" rigid/swing gooseneck spout; 1.0 GPM laminar flow non-aerating outlet. 4" metal wristblade handles; index buttons. "Quaturn"™ rebuildable compression cartridge(HW/CW)
 - c. Drain: Just J-ADA-35 or equal; chrome plated brass, offset tailpiece, removable basket
 - d. P-Trap: McGuire 8903 adjustable trap w/cleanout; 1½" inlet; 2" outlet; with "ProWrap" insulated covers or TruBro LavGuard2 or equal
 - e. Disposer: Insinkerator "Evolution" series, model PRO 880LT; with "MultiGrind" and "SoundSeal" technology; 7/8 hp motor; stainless steel grind components.
8. P-5C SINK (ADA)
- a. Fixture: Just #SL-ADA-1921-A-GR or approved equal; single bowl; 19" X 21" X 4 ½" deep; 18 gauge type 304 stainless steel; 8" centers
 - b. Faucet: Chicago Faucets #786-E65VPCABCP, concealed deck-mount with 8" fixed centers, chrome plated; 5 ¼" rigid/swing gooseneck spout; 1.0 GPM laminar flow non-aerating outlet. 4" metal wristblade

- handles; index buttons. "Quatern"™ rebuildable compression cartridge (HW/CW)
- c. Eyewash: Guardian G1849, deck mounted "AutoFlow" swing-down eyewash less bowl; in-line strainer; (2) spray heads w/flip-top dust covers, filters; 1.6 GPM; ANSI compliant sign
 - d. Drain: Just J-ADA-35 or equal; chrome plated brass; offset tailpiece, removable basket
 - e. Solids Interceptor: Zurn Z1180 or approved equal, acid resistant composite interceptor, in lieu of fixture P-trap, for on floor installation, with removable PVC sediment bucket having removable 3/32" perforated flow defusing screen, top access gasketed secured cover, and ABS handle
9. P-5D GREENHOUSE SINK
- a. Fixture: West Star Industries, Premier Line #SP-1-1717; 14 gauge type 304 stainless steel, tub size 17" x 17"; 1 5/8" Ø adjustable stainless steel feet; cross braced; single hole punched
 - b. Faucet: Chicago Faucets #332-E35ABCP; single hole; 6" s-type swing spout; sofflo aerator 1.5 gpm; vandal proof 2 3/8" lever handle
 - c. Drain: Just J-35 or equal; chrome plated brass with removable cup strainer
 - d. P-Trap: McGuire 8903 trap; 1½" inlet; 2" outlet;
10. P-6 DRINKING FOUNTAIN WITH BOTTLE FILLER
- a. Fixture: Haws #1117LN with 1920 bottle filler; hi-low; wall-mounted; 14 gauge stainless steel; ADA compliant; push-button operated; integral trap; stainless steel back panel
 - b. Mounting Plate: Haws 6700.4

2.20 ELECTRIC WATER HEATER (TANK TYPE)

- A. AO Smith "Dura-Power" series, model DEL, as scheduled on the Drawings or approved equal. Heaters shall be UL listed, and shall meet or exceed the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IESNA 90.1.
- B. The water heaters shall have 150-psi working pressure and shall be equipped with extruded high-density anode rod. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.
- C. The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation. The drain valve shall be located in the front for ease of servicing.
- D. Heater tank shall have a three-year limited warranty as outlined in the written warranty. Complete copies of all warranties and service policies, including all exclusions and conditions, shall be presented to the owner as part of the close-out submittal package.

PART 3 - - EXECUTION

3.1 SITE CONDITIONS

- A. This Contractor shall be held to have examined the site and compared it with the Contract Documents, and to have satisfied himself as to the conditions under which the work is to be

performed. In the event of discrepancy, he shall notify the Architect and proceed as he directs. He shall be held responsible for all existing conditions, whether or not accurately described, and no allowance shall subsequently be made on his behalf for any error, omission, or extra expense to which he may be put due to failure or neglect on his part to make such examination and notification.

- B. Prior to commencing the work of this Section, this Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section and that the completed work will be in complete accordance with the original design. In the event of discrepancy immediately notify the Architect and proceed as directs.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall be responsible for delivery, storage, protection and placing of all equipment and materials.
- B. Contractor shall protect the work and materials from damage during construction. Equipment stored at the jobsite shall be protected from dust, water or other damage, and be covered if equipment is exposed to weather. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 - 1. Any items damaged shall be repaired or replaced, at no additional cost to the Owner.

3.3 COOPERATION WITH OTHER TRADES

- A. Cooperate fully with other trades doing work on the project as may be necessary for the proper completion of the project. Refer to the Structural, Plumbing, and Electrical Drawings for details of the building structure and equipment installation that will tend to overlap, conflict with, or require coordination with the work of this Section, and schedule this work accordingly.
- B. Priority of right of way in space shall be as follows, in decreasing order of authority:
 - 1. Electrical lights, electrical panels and drain piping.
 - 2. Ductwork.
 - 3. Fire protection piping, domestic hot water, domestic cold water and condenser water piping.
- C. Any work done without regard for other trades shall be moved, replaced, or redone as required, without extra charges to Owner.

3.4 DAMAGE BY LEAKS

- A. Contractor shall be responsible for any damage to work of other Contractors that is caused by leaks in any temporary or permanent piping systems due to pipe rupture, disconnected pipes or fittings, or by overflow of equipment.

3.5 CLEANLINESS OF PIPING AND EQUIPMENT SYSTEMS:

- A. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
- B. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
- C. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

- D. Remove, clean and replace all strainer baskets prior to final inspection.

3.6 EQUIPMENT

- A. Equipment shall operate quietly and without objectionable vibration. Such problems, other than from equipment operating at optimum conditions, shall be the Contractor's responsibility and shall be eliminated at the direction of the Engineer.
- B. Install equipment to provide good appearance, easy access, and adequate space to allow replacement and maintenance. Provide bases, supports, anchor bolts, and other items required to achieve this. Installation shall be level, above moisture level, and adequately braced.
- C. Extend ¼" schedule 40 black steel lubrication pipes from hard-to-reach locations to front of equipment or to access doors. Terminate with proper lubrication fittings.
- D. Move equipment into building through available openings. Dismantle equipment where necessary to accomplish this. After reassembly, test equipment to verify its satisfactory operating condition.
- E. Thoroughly lubricate equipment before operating. Repair of damage resulting from failure to comply with this requirement shall be the Contractor's responsibility.
- F. Connections to piping shall be secured and properly aligned and all utility and control connections shall be properly isolated from the building structure by means of vibration isolators and flexible connections. Any equipment not meeting this requirement will be modified and properly reinstalled at no expense to the Owner.

3.7 PAINTING

- A. Properly prepare work under this Section to be painted.
- B. Priming as required herein, shall be of a material compatible with paint for finish painting. All equipment and materials shall be cleaned of grease, wax, oil, rust or dirt in preparation for finish painting. Any prime coated surfaces showing signs of rust before being finish painted shall be thoroughly cleaned and a new prime coat applied.
- C. Prime paint both sides of flashings prior to installation.
- D. Furnish can of touch-up paint with each factory finished piece of equipment.
- E. Black steel piping exposed to the environment shall be painted with rust-inhibiting paint. Color as selected by Architect.

3.8 GENERAL INSTALLATION:

- A. Work performed by experienced journeyman plumbers. No exceptions.
- B. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
- C. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
- D. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.

- E. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to ½" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
1. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
 2. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24" horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.
 3. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
 4. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
 5. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
 6. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
 7. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
 8. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
 9. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
 10. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
 11. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.
- F. Testing:
1. General:
 - a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.

- b. Notify Architect and local Plumbing Inspector 2 days before tests.
 - c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
 - d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1- 1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
 - e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
2. Testing of Pressurized Systems:
 - a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
 3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- G. Corrosive Soil Conditions:
1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
 3. Obtain and review project soils report for verification of requirements concerning corrosive soils.
- H. Protection:
1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.
- I. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- J. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
- K. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- L. Sleeves:
1. Pipe Sleeves:
 - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
 - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through

- floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
- c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
 - c. Seal each end airtight with a resilient nonhardening seal per code.
 3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
 - a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
 - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

3.9 TESTING, INSPECTIONS

- A. This Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at no expense to the Owner, make all repairs necessary to restore both his work and that of other contractors which may have been damaged to be in conformity with the Contract Documents.
- B. This Contractor shall make all tests required by all local, state, and federal laws, codes, ordinances, and regulations having jurisdiction over this work. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test is obtained.

3.10 BELOW GRADE PIPING, GENERAL INSTALLATION REQUIREMENTS

- A. Underground Piping Systems:
 1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.
 2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
 3. Water: Keep excavations free of standing water. Reexcavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.

4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material. Adequate width of trench for proper installation of piping or conduit.
6. Support Foundations:
 - a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.
 - b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
 - c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
Material Passing	Min.	Max.	Min.	Max.
3/4-inch square opening	27	47	0	1

- d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.
7. Backfilling:
 - a. Following installation and successful completion of required tests, backfill piping in lifts.
 - 1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6" in depth to height of 12" above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
 - 2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12 " in depth.
 - b. Backfill Material:
 - 1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
 - 2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."
8. Compaction of Trench Backfill:
 - b. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - 1) Mechanical tamper,
 - 2) Vibratory compactor, or
 - 3) Other approved methods appropriate to conditions encountered.
 - c. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

3.11 DWV PIPING, BELOW GRADE (WITHIN 5-FEET OF BUILDING) INSTALLATION

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- C. Sanitary and Storm Drainage:
 - 1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
 - 2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on direct waste or drain piping exceeding 60".
 - 3. Drains:
 - a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Slope flooring to floor drain a minimum of 1/2" below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
 - 4. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
 - 5. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
 - 6. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.
- D. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut piping with an applied epoxy per manufacturer's instructions. Denso - Protal 7200 fast-cure epoxy repair coating.

3.12 DWV PIPING, ABOVE GRADE INSTALLATION

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- C. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

- D. Sanitary and Storm Drainage:
1. Grade piping at a uniform pitch of 2% unless otherwise noted on Drawings.
 2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on direct waste or drain piping exceeding 60". Changes in direction of indirect waste piping shall be accomplished by the use of appropriate drainage fittings. Drilling and tapping of indirect waste pipes and the use of saddle hubs and bands are prohibited. Protection against breakage of piping passing under or through walls shall be provided using specified sleeves and caulking.
 3. Drains:
 - a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of $\frac{1}{2}$ " below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
 4. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
 5. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
 6. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.
- E. Condenser water piping shall be hydrostatically tested at 125-psi pressure and proved tight before covering. Tests may be made in sections provided connection to service previously tested is included in each succeeding test. Systems shall be tight for eight hours.
- F. Provide all necessary cutting in connection with the work of this Section. No structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity.
- G. Cutting or boring of joists or other structural members shall be done only when alternative routing is impossible and only upon written approval of the Architect or Owner.
- H. All penetrations of concrete or masonry shall be made with core drills. No cutting shall be done without the approval of the Architect.

3.13 HOT AND COLD DOMESTIC WATER, ABOVE GRADE, INSTALLATION

- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
1. Test each pressurized piping system at 150% of operating pressure indicated, but not less than 125 PSIG test pressure.
 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive

quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

- E. Braze copper tube and fitting socket with BCUP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- F. Domestic Water:
1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2". Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

3.14 FLANGES, UNIONS, AND COUPLINGS INSTALLATION

- A. Flanges:
1. Provide flanges at steel or copper piping, valves and equipment, sizes 2-1/2" or larger, unless specified otherwise; weld neck or slip-on pattern.
 2. Bolts: Provide studs (both ends threaded) with hexagon nuts where necessary to facilitate removal of valves or disassembly of flanged systems.
 3. Dielectric Flanged Insulation: Provide on dissimilar metal flanged piping connections.

3.15 CLEANOUTS INSTALLATION

- A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135°; at minimum intervals of 100'; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

- B. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

3.16 INSULATION INSTALLATION

- A. Insulation shall be applied in complete accordance with the manufacturer's published installation instructions. All insulation shall be applied on clean, dry surfaces and shall be continuous through wall and ceiling openings and sleeves, except where fire stop materials are required.
- B. Piping and Equipment:
 - 1. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
 - 2. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position lap on bottom of pipe.
- C. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. Seal all pipe terminations with vapor barrier mastic.
- D. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (60° F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1½" and larger (hot and cold piping).
- E. Inserts shall be installed at outside hangers. Inserts between the pipe and pipe hangers shall consist of rigid closed cell pipe insulation of thickness equal to the adjoining insulation. Inserts shall not be less than 12" long for pipe sizes through 2½" and not less than 18" long for pipes larger than 2 ½". Refer to manufacturer's recommendations for densities, sectional length, gauge of metal shield and distance between centering.
- F. All pipe insulation ends shall be tapered and sealed, regardless of service.
- G. Glass Wool Pipe Insulation
 - 1. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
 - 2. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.
- H. Flexible Elastomeric Insulation
 - 1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive.
 - 2. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
 - 3. Flexible Elastomeric Tubing: Slip insulation over piping or if piping is already installed, it should be slit and snapped over piping. Joints and butt ends must be adhered with 520 adhesive.
- I. ADA Accessible Lavatory/Sink Insulation Kit

1. Provide lavatory/sink insulation kit on waste fittings, hot and cold water stops and supplies.

3.17 IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

A. Piping

1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - a. Adjacent to all valves and flanges
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. At both sides of wall, or floor penetrations.
 - d. Near penetrations through ceilings, and inaccessible enclosures.
 - e. Adjacent to changes in direction.
 - f. At access doors, manholes, and similar access points that permit view of concealed piping.
 - g. Near major equipment items and other points of origination and termination.
 - h. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - i. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
2. All piping shall be identified.

B. Valves

1. For identification and Owner's maintenance records, all valves shall be numbered and identified with clearly stamped tags, in accordance with drawings and service performed.
2. Control valves shall be also marked whether normally open (N.O.) or normally closed (N.S.).

C. Equipment

1. Warning signs shall be placed on machines driven by electrical motors that are controlled by fully automatic starters, per California Code of Regulations, Title 8, Subchapter 7 - General Industry Safety Orders, Article 7, Section 3320.

- D. Valve schedules shall be framed and posted in mechanical rooms or as directed by Owner.

3.18 HANGERS & SUPPORTS INSTALLATION

A. Examination:

1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Preparation:

1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

- D. Pipe supports shall be spaced according to CPC 2016, Table 313.3 and sufficiently close to support pipes properly without formation of pockets. Hangers shall be installed at ends of mains and branches.

- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories as required to support piping from building structure.
- F. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 1. Field assemble and install according to manufacturer's written instructions.
- G. Pipe Guides:
 - 1. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - 2. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
- H. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field -fabricated, heavy-duty trapezes.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
 - a. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
 - b. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
- I. Provide resilient mounting for domestic water piping. Thermal insulation may serve as resilient mounting for insulated piping.
- J. Suspended water piping shall be anchored with steel struts installed at midpoint of each run.
- K. No valve or piece of equipment shall be used to support piping. Do not support piping from other piping.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Flexibility of piping systems must be maintained using flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.
- N. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4" and larger. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions.
- O. Install lateral bracing with pipe hangers and supports to prevent swaying.
- P. Metal Pipe-hanger Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- Q. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping. Install with insulation same thickness as piping.
- R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- S. Pipe Slopes: Install hangers and supports to provide required pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping is not exceeded.
- T. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
- U. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
 3. Riser to be supported at each floor penetration.
 4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- V. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
 2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.
- W. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.
- X. Wall and Floor Sleeves
1. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.
 2. Fabricated Pipe Sleeves:
 - a. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
 - b. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
 - c. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.

- d. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

Y. Building Attachments

1. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.
2. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
3. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
4. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
5. Anchor Bolts:
 - a. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
 - b. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
6. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
7. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.
8. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 - c. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.

Z. Flashing

1. Flash and counter-flash where piping passes through weather or waterproofed walls, floors and roofs.
2. Flash floor drains over finished areas, 10-inches clear on sides, minimum 36" x 36" sheet size. Fasten flashing to drain with clamping device.
3. Install built up fixtures (mop sinks) with water sealing systems/membranes to meet Code. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.19 PIPE WELDING

- A. All hot and chilled water, steam and steam condensate, compressed air and vacuum piping shall be installed, examined, inspected and tested in accordance with the requirements of ASME B31.9, Building Services Piping, current edition.
- B. Perform all welding to AWS D1.1. Weld all pipe 2.5" and larger. Use the following procedure. All welders must be AWS certified. AWS B2.1 SMAW 6G Pipe Welding Procedure Specifications

Welding process: SMAW
Position: 6G Fixed position

Grove Angle: 60°
Material/Spec: A 106

Weld Progression: Up
 Backing: No
 Current/Polarity: DCEP
 Root Opening: 1/16 to 1/8

Thickness (pipe/tube): Groove (in) .280
 Notes: Sch. 40 Pipe
 Filler Metal Class: E6010Rt/E7018F1
 Other Filler Metal Class: Rt. 1/8, 3/32 Filler

- C. Welded joints shall be beveled and butt-welded. Reductions of pipe shall be made with forged steel welding fittings. Branch reductions of two or more pipe sizes smaller than the main, may be Bonney "Weld-O-Let" fittings or equal. Job fabricated reductions and branches shall not be used. All pipe burrs shall be reamed out. Welding rods shall be as follows, or approved equal:

<u>Pipe Size</u>	<u>Arc Welding</u>	<u>Gas Welding</u>
2" and larger	Fleetweld #5	Oxweld #1 or Page Hi-Test M
1½" and smaller	None	Oxweld #1 or Page Hi-Test M

3.20 PLUMBING FIXTURES INSTALLATION

- A. Space between wall mounted fixtures and wall surface shall be neatly pointed up with G.E. silicone rubber compound of color matching fixture.
- B. All exposed bolt heads and nuts used to secure fixtures shall be concealed with vitreous china caps.

3.21 DOMESTIC WATER SYSTEM STERILIZATION

- A. Upon completion of this work, the new domestic water system shall be thoroughly flushed, sterilized and re-flushed. Sterilization and re-flushing shall be performed using the procedure below. All work shall be performed in the presence of the inspector.
- B. All domestic water outlets shall have signs posted at their location stating that the water has not been sterilized and shall not be used for human consumption. The signs shall remain until the sterilization process is complete.
- C. Provide water line disinfections performed by a D1 Water Operator licensed in the State of California.
- D. Procedure:
 - 1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 - 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
- E. After a period of 48 hours minimum, bacteriological tests, using samples from at least 3 representative points, shall be made by recognized testing agency, who shall certify to the Architect that the system is bacteriologically safe and at least equal in safety to that of the principal water supply. The laboratory report and certification shall be transmitted to the Architect.
- F. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.

3.22 ADJUSTING

- A. Properly adjust all stops, and controls, and demonstrate safe and satisfactory operation of all equipment.

3.23 CLEANUP

- A. Upon completion of the work of this Section, remove all surplus material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION



P-1

Madera™ FloWise® 15" Height Elongated Flushometer Toilet

VITREOUS CHINA with EVERCLEAN®

Madera™ FloWise® 15" Height Elongated with EverClean®

- Floor mount flushometer valve toilet
- Vitreous china
- High Efficiency, Low Consumption. Operates in the range of 1.1 gpf to 1.6 gpf (4.2 Lpf to 6.0 Lpf)
- Meets definition of HET (High Efficiency Toilet) when used with a high efficiency flush valve (1.28 gpf or 1.6 / 1.1 gpf dual flush)
- Permanent EverClean® surface inhibits the growth of stain and odor-causing bacteria, mold, and mildew on the surface
- Fully glazed 2-1/8" trapway
- Elongated bowl
- 10" or 12" roughing-in
- 15" rim height
- Condensation channel
- Powerful direct-fed siphon jet action
- 10" x 12" water surface area
- 1-1/2" inlet spud
- 2 bolt caps

- 3451001** Elongated bowl only, top spud
- 3452001** Elongated bowl only, top spud with slotted rim for bedpan holding
- 3453001** Elongated bowl only, back spud
- 3455001** Elongated bowl only, back spud with slotted rim for bedpan holding

System MaP* Score:

- 1,000 grams of miso @ 1.1 gpf, 1.28 gpf or 1.6 gpf when used with an American Standard flush valve

* Maximum Performance (MaP) testing performed by IAPMO R&T Lab. MaP Report conducted by Veritec Consulting, Inc. and Koeller and Company.

Component Parts:

- 047007-0070A** Inlet Spud (furnished with bowl)
- 481310-100** Bolt caps with retainers (furnished with bowl)

Nominal Dimensions:

718 x 356 x 381mm
(28-1/4" x 14" x 15")

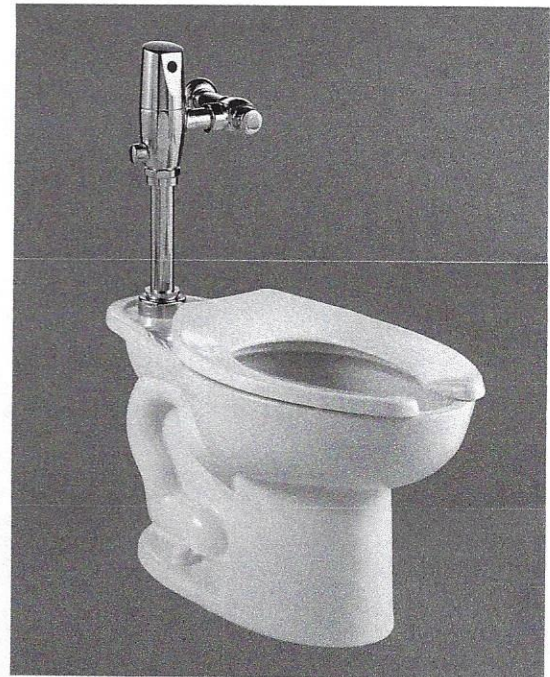
Fixture only, less seat and flush valve

Recommended working pressure—between 25 psi at valve when flushing and 80 psi static

Compliance Certifications -

Meets or Exceeds the Following Specifications:

- ASME A112.19.2 / CSA B45.1 for Vitreous China Fixtures



SEE REVERSE FOR ROUGHING-IN DIMENSIONS

To Be Specified:

- Color: White
- Seat:
 - American Standard #5901.100 Heavy duty open front less cover
 - American Standard #5905.100 Extra heavy duty open front less cover
- Flushometer Valve:
 - 1.6 gpf:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.161.002 (Top Spud)
 - Sensor-Operated: American Standard Selectronic® AC Power #6067.261.002 (Back Spud)
 - Manual: American Standard #6047.161.002 (Top Spud)
 - 1.28 gpf:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.121.002 (Top Spud)
 - Sensor-Operated: American Standard Selectronic® AC Power #6067.221.002 (Back Spud)
 - Manual: American Standard #6047.121.002 (Top Spud)
 - 1.6 / 1.1 gpf Dual Flush:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.761.002 (Top Spud)



ENVIRONMENTAL
PRODUCT
DECLARATION



When used with
1.1 or 1.28 gpf
toilet flush valves



EVERCLEAN



WATER
EFFICIENT



BARRIER FREE

P-1A

MADERA™ FloWise® 16-1/2" HEIGHT ELONGATED FLUSHOMETER TOILET

VITREOUS CHINA with EVERCLEAN®

MADERA™ FloWise® 16-1/2" HEIGHT ELONGATED with EVERCLEAN®

- Floor mount flushometer valve toilet
- Vitreous china
- High Efficiency, Low Consumption. Operates in the range of 1.1 gpf to 1.6 gpf (4.2 Lpf to 6.0 Lpf)
- Meets definition of HET (High Efficiency Toilet) when used with a high efficiency flush valve (1.28 gpf or 1.6 / 1.1 gpf dual flush)
- Permanent EverClean® surface inhibits the growth of stain and odor-causing bacteria, mold, and mildew on the surface
- Fully glazed 2-1/8" trapway
- Elongated bowl
- 10" or 12" roughing-in
- 16-1/2" rim height for accessible application
- Condensation channel
- Powerful direct-fed siphon jet action
- 10" x 12" water surface area
- 1-1/2" inlet spud
- 2 bolt caps
- 100% factory flush tested

- 3461.001** Elongated bowl only, top spud
- 3462.001** Elongated bowl only, top spud with slotted rim for bedpan holding (White only)
- 3465.001** Elongated bowl only, top spud with 4 bolts (White Only)
- 3466.001** Elongated bowl only, top spud with slotted rim for bedpan holding with 4 bolts (White only)
- 3463.001** Elongated bowl only, back spud
- 3464.001** Elongated bowl only, back spud with slotted rim for bedpan holding (White only)

System MaP* Score:

- 1,000 grams of miso @ 1.1 gpf, 1.28 gpf or 1.6 gpf when used with an American Standard flush valve

* Maximum Performance (MaP) testing performed by IAPMO R&T Lab. MaP Report conducted by Veritec Consulting, Inc. and Koeller and Company.

Component Parts:

- 047007-0070A** Inlet Spud (furnished with bowl)
- 481310-100** Bolt caps with retainers (furnished with bowl)

Nominal Dimensions:

718 x 356 x 419mm
(28-1/4" x 14" x 16-1/2")

Fixture only, less seat and flush valve

Recommended working pressure—between 25 psi at valve when flushing and 80 psi static

Compliance Certifications -

Meets or Exceeds the Following Specifications:

- ASME A112.19.2-2008 / CSA B45.1-08 for Vitreous China Fixtures



SEE REVERSE FOR ROUGHING-IN DIMENSIONS

To Be Specified:

- Color: White Bone Linen
- Seat:
 - American Standard #5901.100 Heavy duty open front less cover
 - American Standard #5905.100 Extra heavy duty open front less cover
- Flushometer Valve:
 - 1.6 gpf:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.161.002 (Top Spud)
 - Sensor-Operated: American Standard Selectronic® AC Power #6067.261.002 (Back Spud)
 - Manual: American Standard #6047.161.002 (Top Spud)
 - 1.28 gpf:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.121.002 (Top Spud)
 - Sensor-Operated: American Standard Selectronic® AC Power #6067.221.002 (Back Spud)
 - Manual: American Standard #6047.121.002 (Top Spud)
 - 1.6 / 1.1 gpf Dual Flush:
 - Sensor-Operated: American Standard Selectronic® DC Power #6065.761.002 (Top Spud)



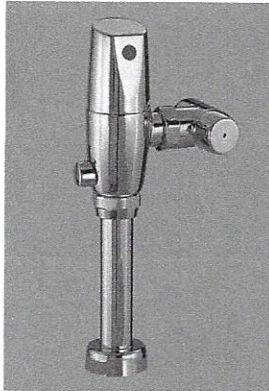
MEETS THE AMERICANS WITH DISABILITIES ACT GUIDELINES AND ANSI A117.1 REQUIREMENTS FOR ACCESSIBLE AND USABLE BUILDING FACILITIES - CHECK LOCAL CODES.

EVERCLEAN®
Surface



SELECTRONIC® SENSOR-OPERATED
TOILET FLUSH VALVE, 1.1 GPF
PWRX™ 10-YEAR BATTERY SYSTEM

P-1, P-1A



MODEL NUMBER:

6066.111.002 Exposed, sensor-operated toilet flush valve, 1.1 gpf.

Inlet includes 1" sweat solder kit and angle stop with back flow protection and vandal-resistant cap.

Outlet includes 1-1/2" high back pressure vacuum breaker with spud coupling and flange.

OPERATING PRESSURE:

25 psi (flowing) - 80 psi (static)

FLOW REQUIREMENT:

25 gpm (94.6 L/min.)

BATTERY LIFE:

10 years (4,000 flushes per month)

OPTIONAL ACCESSORIES:

- Cast wall flange: 1" (6065.810)
- Split ring pipe supports: 2-1/2" C-E (6065.822) & 6" C-E (6065.862)

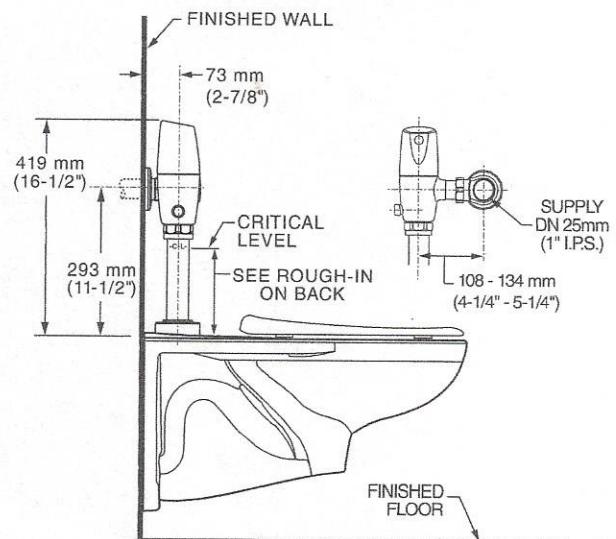
GENERAL DESCRIPTION:

Exposed, sensor-operated Selectronic® Toilet Flush Valve for floor-mounted or wall-hung 1-1/2" top spud bowls. PWRX 10-Year Battery System.

PRODUCT FEATURES:

- **PWRX™ Battery System:** Advanced battery & electronics reduce the downtime and maintenance costs associated with changing batteries
- **Safety Circuitry** prevents overheating of the battery in case of short circuit, protecting the electronics
- **No Routine Maintenance:** no diaphragms to replace; no filters to clean
- **Self-Cleaning Piston** with integral wiper spring significantly reduces clogging and maintenance
- **Selectronic® Proximity System** with universal sensor provides hygienic, "hands free" operation
- **Dezincification Resistant** brass alloy
- **Fully Mechanical Manual Override Button** can flush the valve without power
- **Fail-Safe:** Valve automatically closes upon loss of power or water pressure and does not need to be reset
- **Adjustable Sanitary Flush** cleans the fixture & maintains the trap seal.
- **Chemical Resistant EPDM Seals** for extended life
- **High Back Pressure Vacuum Breaker**
- **Adjustable Tailpiece**
- **Range can be adjusted manually or with optional remote control**
- **No external volume adjustment.**
- **Can be installed left or right handed**

TYPICAL WATER CLOSET INSTALLATION:
AFWALL® TOILET SHOWN



RECOMMENDED SPECIFICATION:

Electronic, sensor activated toilet flush valve shall feature self-cleaning piston valve with integral wiper spring in refill orifice to prevent clogging. Includes a long-life battery pack (with 10 year life) and fully mechanical manual override that can flush the valve without power. Includes dezincification-resistant brass valve body and metal cover with chrome finish. Includes angle stop with back-flow protection & vandal-resistant cap. Sweat solder kit and high back pressure vacuum breaker also included. 1.1 gpf / 4.2 Lpf flush valve shall be American Standard Model # 6066.111.002.

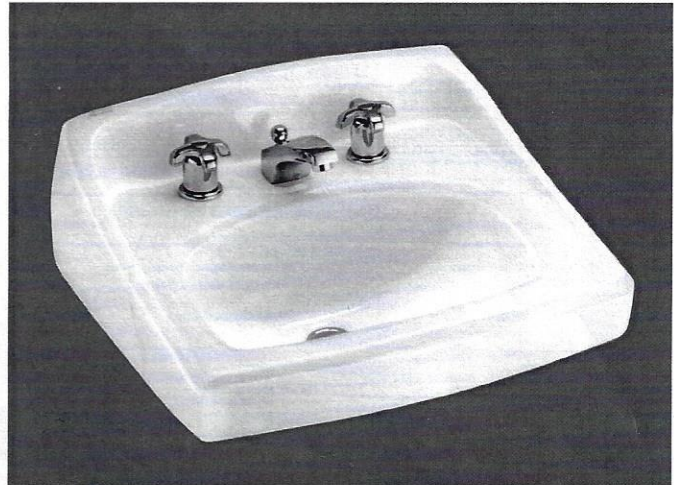


LUCERNE™ WALL-HUNG LAVATORY

- Wall-hung sink
- Vitreous china
- Front overflow
- D-shaped bowl
- Self-draining deck area with contoured back and side splash shields
- Faucet ledge
- Compliant with Texas accessibility standard (TAS) for children age group 13 and up

Faucet holes on 203mm (8") centers (Illus.):

- 0356.028** For exposed bracket support
Shown with 4801.862 Amarelis Heritage faucet with Triune Cross handles (not included)
- 0356.015** For wall hanger (included) or concealed arms support
- 0356.915** For wall hanger (included) or concealed arms support
 - Less overflow



0356.028

Faucet holes on 102mm (4") centers:

- 0355.027** For exposed bracket support
- 0355.012** For wall hanger (included) or concealed arms support
- 0355.912** For wall hanger (included) or concealed arms support
 - Less overflow



0356.041

Single center faucet hole (Illus.):

- 0356.041** For exposed bracket support
Shown with 1340.000 metering faucet (not included)
- 0356.421** For wall hanger (included) or concealed arms support
- 0356.921** For wall hanger (included) or concealed arms support
 - Less overflow
- 0356.439** For wall hanger (included) or concealed arms support
 - Single faucet hole on right
- 0356.066** For exposed bracket support
 - Single faucet hole on right

Nominal Dimensions:

521 x 464mm
(20-1/2" x 18-1/4")

Bowl sizes:

381mm (15") wide
254mm (10") front to back
165mm (6-1/2") deep

Compliance Certifications -

Meets or Exceeds the Following Specifications:

- ASME A112.19.2 / CSA B45.1 for Vitreous China Fixtures

SEE FOLLOWING PAGES FOR ROUGHING-IN DIMENSIONS

To Be Specified:

- Color: White
- Faucet*:
- Faucet Finish:
- Supplies:
- 1-1/4" Trap:
- Nipple:
- Bracket Support (by others):
- Concealed Arms Support (by others):

* See faucet section for additional models available



MEETS THE AMERICANS WITH DISABILITIES ACT GUIDELINES AND ANSI A117.1 ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES - CHECK LOCAL CODES.
Top of front rim mounted 864mm (34") from finished floor.

CODE NUMBER

3365784BT

DESCRIPTION

4" Trim Plate, Box Transformer Power Supply, Back-Check Tee, Polished Chrome Finish, 0.35 gpm, Multi-Laminar Spray, Infrared Sensor, Smart Faucet, Optima® Hardwired-Powered Deck-Mounted Mid Body Faucet.

DETAILS

- Flow Rate: 0.35 gpm (1 Lpm) (0.35GPM)
- Spray Type: Multi-Laminar (MLM)
- Sensor Type: Infrared (IR)
- Mounting Type: 4" Centerset
- Trim Plate: 4" (102mm) (4)
- Power Supply: Box Transformer (BOX)
- Temperature Mixer: Back-Check Tee (TEE)
- Finish: Polished Chrome (CP)
- Factory Default Timeout: 30s
- Factory Default GPC: 0.25

FEATURES

Commercial Grade Faucet, ADA Compliant, Cast Brass Spout, Quick Connect Fittings, Integrated Water Shut-off, Wireless Settings Adjustment, On-demand or Metered activation, Hygienic Line Flush, Water Usage and Battery Strength Reporting, Self-adapting Sensor

ELECTRICAL SPECIFICATIONS

- Self-Adjustment Range: 1" -8" (25-203mm)
- Sensor Range: 4"-5" (102-127mm)
- Timeout Adjustment Settings: 30s

POWER SUPPLY OPTIONS

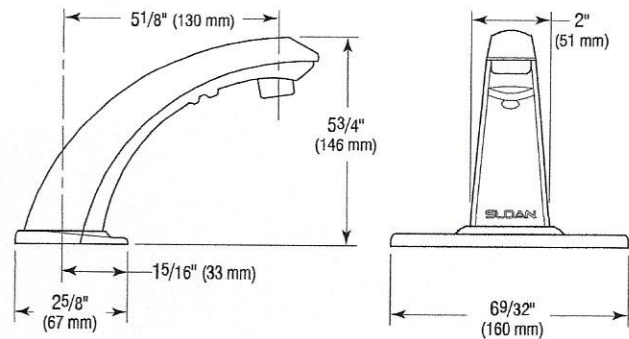
- 6VDC Plug Adapter (included with PLG models)
- 6VDC Ganged Adapter Kit (up to 6 units)(sold separately)
- 24VAC Box Transformer (included with BOX models)

VIDEOS

- ▶ Optima Faucet App
- ▶ Sloan Optima Below Deck Faucet

DOWNLOADS

- Optima Smart Faucet Below Deck Installation Instructions
- Trim Plate Guide
- Faucet Spray Heads Repair and Maintenance Guide
- ETF-80/880 and EBF-85/187 Below Deck Repair and Maintenance Guide
- Additional Downloads



COMPLIANCES & CERTIFICATIONS



(ADA Compliant, ASME A112.18.1 Compliant, CalGreen Compliant, CEC Compliant, cUPC Certified, cUPC Low Lead Compliant, GPC 0.25 or less, NYC604.4, Proposition 65, TAS, UL Certified, UPC Certified, UPC Low Lead Compliant, LEED V4 Water Efficiency Credit)

RECOMMENDED SPECIFICATION

Faucet shall include cast brass body, quick-connect fittings, twist-off/shut-off solenoid assembly, removable battery cartridge, flexible power supply and allow adjustment of settings wirelessly via Apple or Android smartphones.

NOTES

All information contained within this document subject to change without notice.

Looking for other variations of the ETF-80 product? [View the general spec sheet with all options.](#)

[Find a matching soap dispenser for this faucet.](#)
[Find a compatible sink for this faucet.](#)

KOHLER®

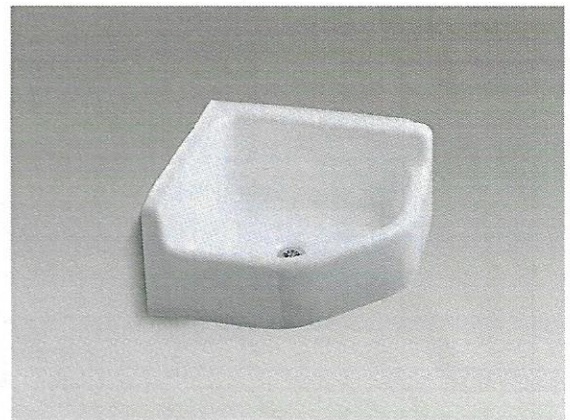
Whitby™ Service Sink K-6710

Features

- KOHLER® cast iron.
- Floor-mount.
- Corner basin.
- Acid-resistant enamel finish.
- Without overflow.
- No faucet holes; requires wall-mount faucet.
- 28" (711 mm) x 28" (711 mm)

Optional Accessories

K-8940 Sink Rim Guard



Codes/Standards

ASME A112.19.1/CSA B45.2

KOHLER® Lifetime Limited Warranty for Cast Iron Components

See website for detailed warranty information.

Available Color/Finishes

Color tiles intended for reference only.

Color	Code	Description
	0	White

MECHANICAL FAUCETS

897-CP

Manual Faucets



a Geberit company

P-4

Product Type

Wall Mounted 8" Body, Adjustable Arms 7-5/8" - 8-3/8" Hot and Cold Water Sink Faucet

Features & Specifications

- 8" Body, Adjustable Arms 7-5/8" - 8-3/8"
- 2-3/8" Vandal Proof Lever Handle
- Ceramic 1/4 Turn Operating Cartridge
- 1/2" NPT Adjustable Female Union Nut Supply Arms
- 3/4" Male Hose Thread Outlet
- Integral Stop Valves for Servicing the product
- Atmospheric Vacuum Breaker, Not Intended for Continuous Pressure Applications
- Vacuum Breaker Spout with Pail Hook and Wall Brace
- Atmospheric Vacuum Breaker, Not Intended for Continuous Pressure Applications
- CFNow! Item Ships in 3 Days

Performance Specification

- Rated Operating Pressure: 20-125 PSI
- Rated Operating Temperature: 40-140°F

Warranty

- Lifetime Limited Faucet Warranty
- 5-Year Limited Cartridge Warranty
- 1-Year Limited Finish Warranty

Codes & Standards

- ASME A112.18.1/CSA B125.1
- ADA ANSI/ICC A117.1

Job Name _____

Item Number _____

Section/Tag _____

Model Specified _____

Architect _____

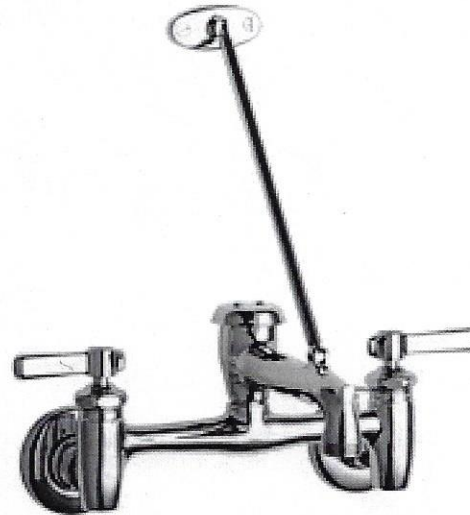
Engineer _____

Contractor _____

Submitted as Shown

Submitted with Variations

Date _____



2100 South Clearwater Drive
Des Plaines, IL
P: 847/803-5000
F: 847/803-5454
Technical: 800/TEC-TRUE
www.chicagofaucets.com

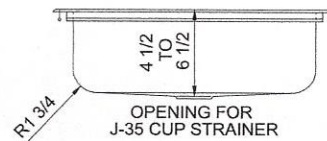
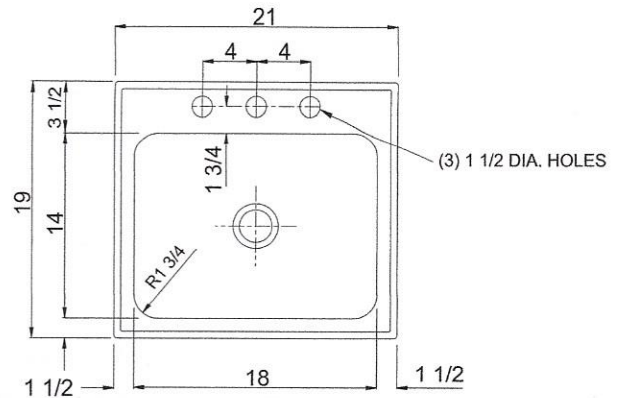
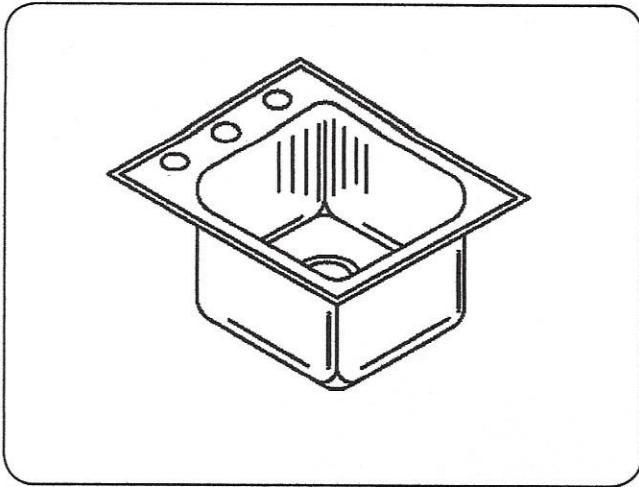
P-5A, P-5B, P-5C



SL-ADA-1921-A-GR

STYLIST GROUP
LEDGE TYPE - SINGLE BOWL
18 GAUGE

SUBMITTAL DATA



SPECIFICATION

Seamless die-drawn construction of Type 304, 18-8 stainless steel. Interior and top surfaces polished to a non-porous Hand-Blended Just Finish with highlighted bowl rim. Fully coated underside insulated for sound and reduces condensation. Straight-sided compartment with radius corners provides greater capacity. Self-rimming top mount Grip-Rim Plus with stainless steel mounting channels. Conforms to ASME/ANSI A112.19.3M. Certified conformance with ASME A112.19.3/CSA B45.4, Canadian Standards (CSA), Uniform Plumbing Code (UPC) and International Plumbing Code (IPC) and Americans with Disabilities Act(ADA). Drain punch 3-1/2" centered for Just J-35 drain.

TYPE 316 STAINLESS STEEL (Check if applicable)

CUTOUT DIMENSIONS

Model Number	Front-to-Back	Left-to-Right
SL-ADA-1921-A-GR	18-1/4	20-1/4

APPROVED FOR MANUFACTURING

MODEL NO.: SL-ADA-1921-A-GR QTY: _____

JOB NAME: _____

TAG/ITEM: _____

CUSTOMER: _____

SIGNATURE: _____

6.85
Gallon
Capacity*

Capacity Matters

Max ID sizing with straight sided bowl configuration (non tapered sides). Tight corner radius design.

*Capacity is based on 6-1/2" Depths

FAUCET PUNCHING - MUST BE SPECIFIED				
<input type="checkbox"/> (1) Hole Centered				
<input type="checkbox"/> (2) Holes on 4" centers				
<input type="checkbox"/> (3) Holes on 4" centers (illustrated)				
<input type="checkbox"/> Alternate Punching: Faucet Model: _____		Punching Required: _____		
DEPTH - MUST BE SPECIFIED:				
<input type="checkbox"/> 4 1/2" DEEP	<input type="checkbox"/> 5" DEEP	<input type="checkbox"/> 5-1/2" DEEP	<input type="checkbox"/> 6" DEEP	<input type="checkbox"/> 6-1/2" DEEP
DRAIN LOCATION - MUST BE SPECIFIED:				
<input type="checkbox"/> CENTER	<input type="checkbox"/> CENTER REAR	<input type="checkbox"/> LEFT REAR	<input type="checkbox"/> RIGHT REAR	



JUST MFG. COMPANY CONTINUES TO MAKE QUALITY AND FUNCTIONALITY A MARK OF THE JUST PRODUCT LINE. TO DO SO REQUIRES THAT WE RESERVE THE RIGHT TO CHANGE PRODUCT INFORMATION WITHOUT NOTICE. DIMENSIONS MAY VARY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. NO RESPONSIBILITY IS ASSUMED FOR USE OF SUPERSEDED OR VOIDED DATA. FOR THE MOST CURRENT AND ACCURATE INFORMATION REGARDING THE COMPLETE LINE OF JUST SINKS, FAUCETS AND DRAINS, CLICK ON THE SPEC LINE DRAWINGS LINK ON OUR WEB SITE AT www.justmfg.com

JUST MANUFACTURING COMPANY

9233 KING STREET . FRANKLIN PARK . ILLINOIS . 60131-2111

PH: 847-678-5150 . FAX: 847-678-6817 . E-MAIL: custserv@justmfg.com . www.justmfg.com

P-5A, P-5B, P-5C

Manual Sink Faucets 786-E65VPCABCP



Geberit Group

Product Type

Deck-mounted manual sink faucet with 8" centers

Features & Specifications

- 8" fixed centers
- 5-1/4" rigid/swing gooseneck spout
- Vandal Proof Pressure compensating laminar flow non-aerating outlet 1.0 GPM
- Vandal Proof 4" wristblade handle
- Quatum™ compression operating cartridge, left-hand
- Quatum™ compression operating cartridge, right-hand
- ECAST® design provides durable construction with total lead content equal to or less than 0.25% by weighted average
- Complies with the requirements of the Buy American Act of 1933.

Performance Specification

- Rated Operating Pressure: 20-125 PSI
- Rated Operating Temperature: 40-140°F

Warranty

- 5-Year Limited Cartridge Warranty
- Lifetime Limited Faucet Warranty
- 1-Year Limited Finish Warranty

Codes & Standards

- ADA ANSI/ICC A117.1
- ASME A112.18.1/CSA B125.1
-
- Certified to WaterSense by CSA
- NSF/ANSI 61, Section 9

Job Name _____

Item Number _____

Section/Tag _____

Model Specified _____

Architect _____

Engineer _____

Contractor _____

Submitted as Shown

Submitted with Variations

Date _____



ECAST

ECAST products are intended for installation where state laws and local codes mandate lead content levels or in any location where lead content is a concern.

2100 South Clearwater Drive
Des Plaines, IL
P: 847/803-5000
F: 847/803-5454
Technical: 800/TEC-TRUE
www.chicagofaucets.com

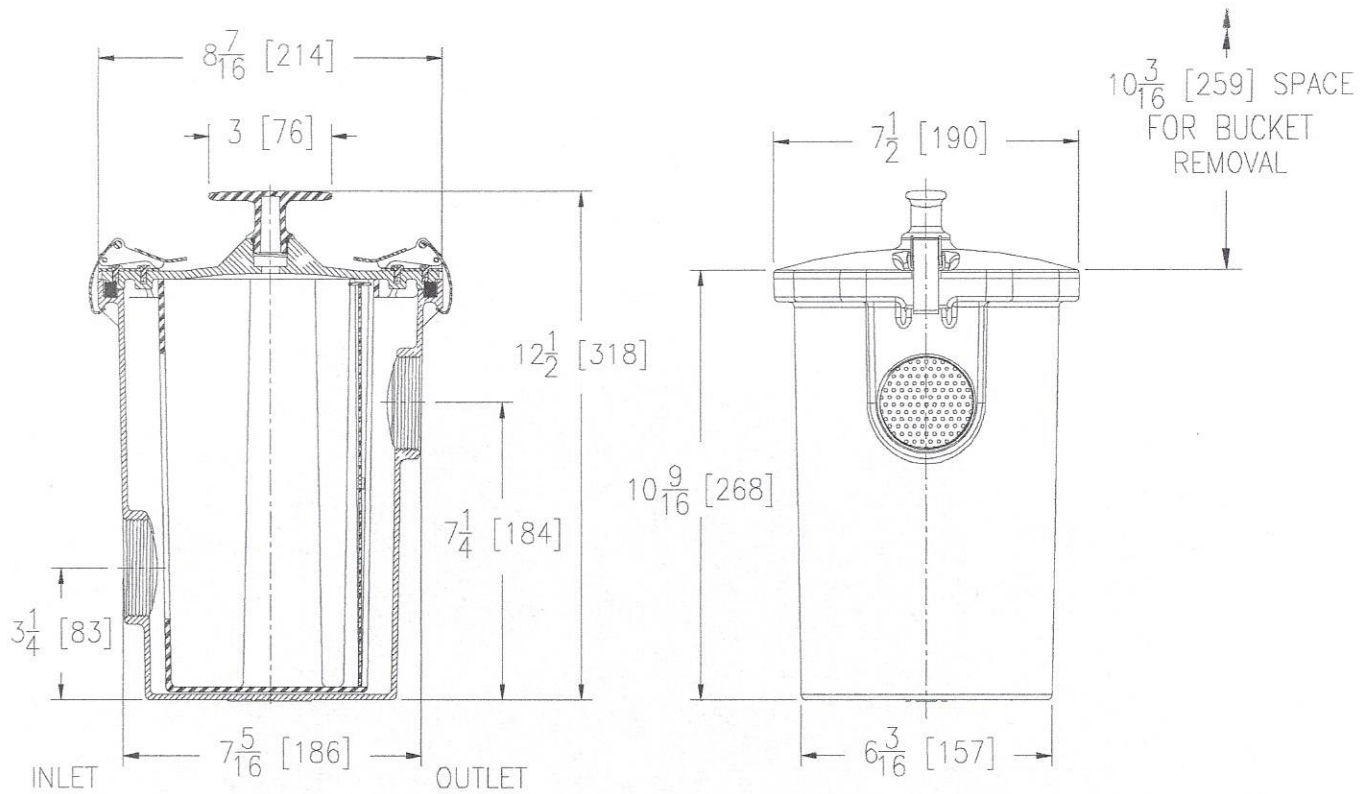


Z1180 SOLIDS INTERCEPTOR

SPECIFICATION SHEET

TAG P-5A, P-5C

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



Inlet/Outlet Inches	Flow Rate GPM [L]	Approx. Wt. Lbs. [kg]
1-1/2, 2** [38, 50]	15 [57]	6 [3]

ENGINEERING SPECIFICATION: ZURN Z1180

Acid Resistant Composite Interceptor, in lieu of fixture 'P' trap, for on-floor installation, with removable PVC sediment bucket having a removable 3/32 [2] dia. perforated flow defusing/intercepting PVC screen, with top access gasketed secured cover, stainless steel draw latches and hardware with an ABS handle for easy removal of sediment bucket and screen. Regularly furnished with 2 [51] threaded low inlet and high outlet.**

OPTIONS (Check/specify appropriate options)

PREFIXES

- ___ Z Acid Resistant Composite*
- ___ ZA Acid Resistant Coated Fabricated Steel (Design different than what is shown.)

SUFFIXES

- ___ -CS Custom Screens (Specify Material And Perforation Size Required)
- ___ -RS Replacement 3/32 [2] Dia. Perforated Screen For Bucket
- ___ -SS Stainless Steel 3/32 [2] Dia. Perforated Screen for Bucket
- ___ -Y Replacement Bucket Assembly With 3/32 [2] Dia Perforated Screen

REV. E	DATE: 7/19/10	C.N. NO. 111398
DWG. NO. 58912	PRODUCT NO. Z1180	

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

ZURN INDUSTRIES, LLC ♦ SPECIFICATION DRAINAGE OPERATION ♦ 1801 Pittsburgh Ave. ♦ Erie, PA 16514

Phone: 814/455-0921 ♦ Fax: 814/454-7929 ♦ World Wide Web: www.zurn.com

In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905/405-8272 Fax: 905/405-1292

P-5B



PRO Series® Food Waste Disposers



PRO 880LT™ Evolution Series®

More Performance in
a Compact Size.

Submittal Sheet

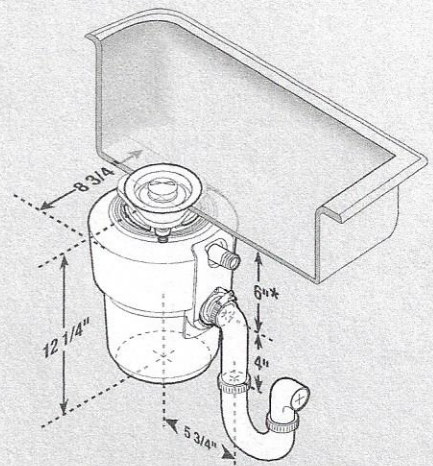
More Performance in a Compact Size.

- **SoundSeal®** technology delivers quieter performance. Hold a conversation with elevated voices in the same room.
- **MultiGrind®** technology delivers 2 stages of grind vs. 1 stage in standard disposer.
- Includes sound-reducing **Quiet Collar®** Sink Baffle containing antimicrobial material.

Specifications

Type of Feed	Continuous
On/Off Control	Wall Switch
Motor	Single Phase
HP	7/8
Reversing	Auto-Reverse Grind System® feature
Volts	120
HZ	60
RPM	1725
Amp. (Avg. Load)	7.8
Time Rating	Intermittent
Lubrication	Permanently Lubricated Upper & Lower Bearings
Shipping Weight (Approx.)	20.1 lbs.
Unit Finish	Black Enamel Black
Overall Height	12-1/4"
SoundSeal Plus Technology	Anti-Vibration Mount® Anti-Vibration Tailpipe Mount™ Antimicrobial Quiet Collar® Sink Baffle SoundLimiter™ Insulation
MultiGrind Technology	GrindShear Ring®
Grind Chamber Capacity	34.6 oz.
Motor Protection	Manual Reset Overload
Average Water Usage	Approx. 1 Gallon Per Person Per Day
Average Electrical Usage	3-4 KWh Per Year
Drain Connection	1-1/2" Anti-Vibration (Hose Clamp)
Dishwasher Drain Connection	Yes

Dimensions



* Add 1/2" when stainless steel sinks are used.

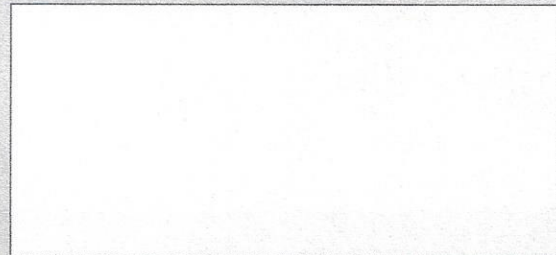
Sample Specification

Food Waste Disposer(s) shall be InSinkEratOr Model PRO 880LT™ with MultiGrind® and SoundSeal® technologies, 7/8 HP motor, Auto-Reverse Grind System® feature and Stainless Steel Grind components.

Warranty:
We Come To You® 8-Year In-Home Limited Warranty.

* The complete InSinkEratOr warranty is included in the Care & Use Booklet packed with each unit.

Job Specifications



MADE IN USA
Disposers are designed and manufactured in the USA with over 80% domestic content



1-800-558-5700
www.insinkerator.com



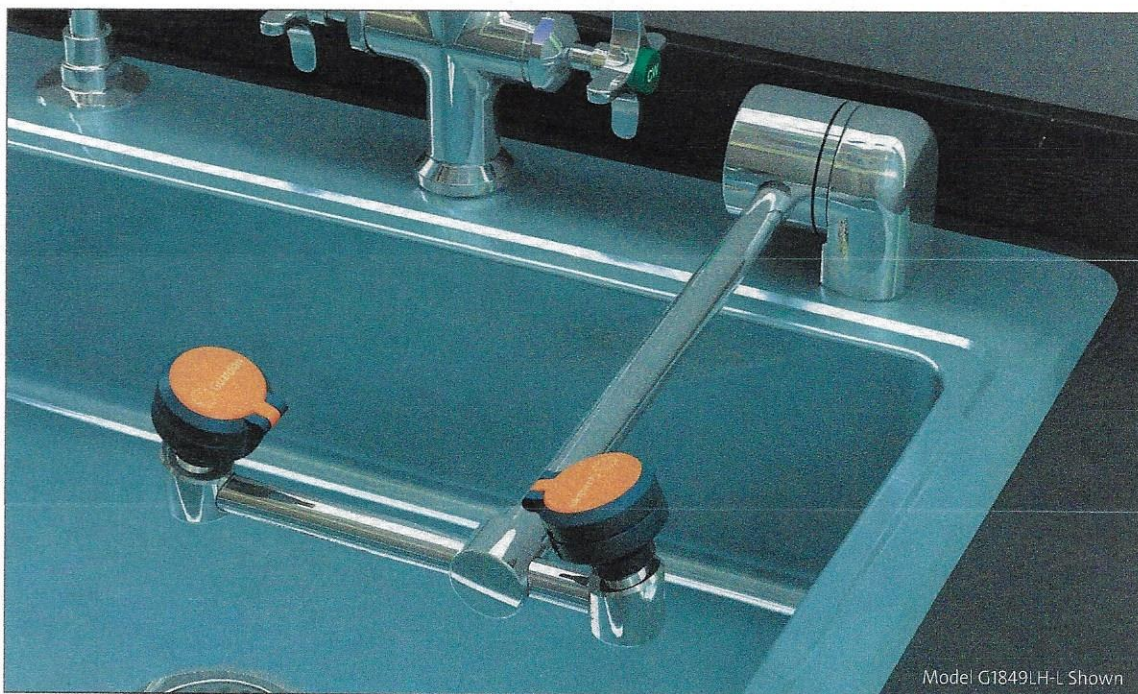
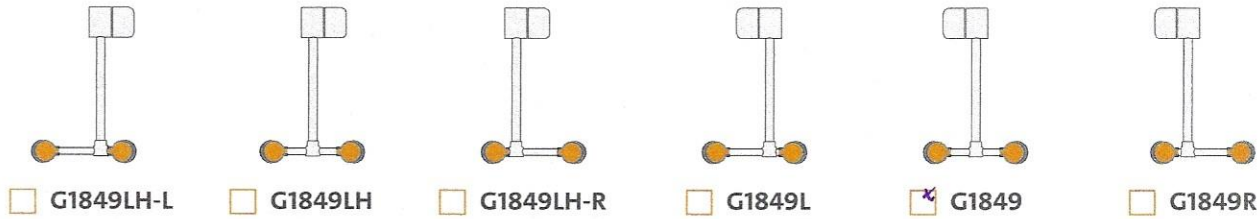
EMERSON™
Commercial & Residential Solutions

The Emerson logo is a trademark and service mark of Emerson Electric Co. The mounting collar configuration is a trademark of Emerson Electric Co. Quick Lock® is a registered trademark of Emerson Electric Co.

InSinkEratOr may make improvements and/or changes in the specifications at any time, in its sole discretion, without notice or obligation and further reserves the right to change or discontinue models.



G1849 Eyewash, Deck Mounted, AutoFlow™ 90° Swing-Down



Model G1849LH-L Shown

Application: AutoFlow™ eyewash for mounting on counter. Spray heads swing down from storage to operational position, activating water flow. Available in a variety of spray head configurations to minimize obstructions at a sink. *Note: If unit is not installed at a sink, floor drain should be provided underneath unit to prevent accumulation of water on floor.*

Spray Head Assembly: Two GS-Plus™ spray heads. Each head has a “flip top” dust cover, internal flow control and filter to remove impurities from the water flow.

Valve: 1/2" IPS plug-type valve with PTFE coated O-ring seals. Swinging head assembly down from storage to operational position opens orifice and activates water flow. Unit remains in operation until spray head assembly is returned to storage position.

Strainer: Unit is furnished with in-line strainer to protect valve and spray heads from debris in water line.

Mounting: Valve is installed in chrome plated brass housing. Unit mounts on countertop behind sink. Furnished with mounting hardware for securing unit to counter.

Construction: Polished chrome plated brass.

Supply: 1/2" NPT female inlet.

Sign: ANSI-compliant identification sign.

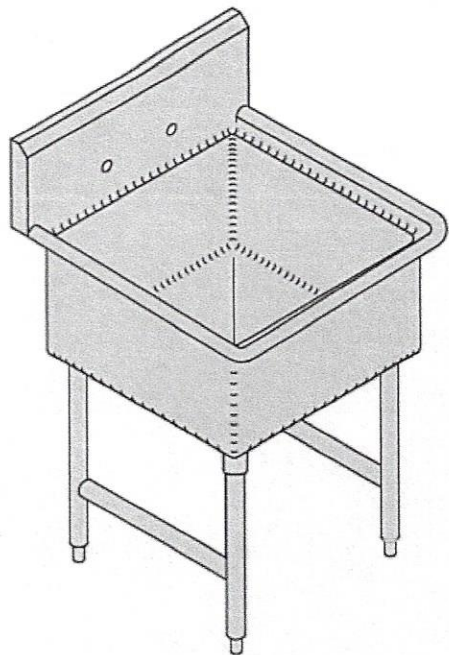
Quality Assurance: Unit is completely assembled and water tested prior to shipment.

Available Options

G3600LF Thermostatic mixing valve precisely blends hot and cold water to deliver warm (tepid) water as required by ANSI Z358.1-2014. Refer to “Tempering Valves” section for complete technical and product selection information.



Item #: _____ Qty #: _____
 Model #: _____
 Project: _____



Features:

- Fully welded and polished tub
- Heavy duty construction
- Cross bracing adds strength and durability
- Includes mounting bracket for easy installation

Construction:

- All sinks are fully welded and polished to a smooth grained finish.
- Backsplash turns down for a simple, sanitary installation
- 1 set of 8" on center faucet holes
- Includes s/s basket drain

Material:

Work Top: 14 gauge type "304" series stainless steel
Legs: 1 5/8" Ø stainless steel with adjustable feet
Gussets: Stainless steel

Custom Sizes Available!

Options:

- Right Splash
- Left Splash
- Faucet 12" spout
- Pre-rinse faucet
- Add-on faucet
- Leverwaste bracket
- Leverwaste
- Leverwaste w/ overflow
- Flange feet
- Hi-Lite Leading Edges
- Other _____

MODEL NUMBER	OVERALL DIMENSIONS		TUB SIZE		WT. (LBS.)
	A	B	C	D	
SP-1-1717	22"	22 1/2"	17"	17"	50
SP-1-1723	22"	28 1/2"	17"	23"	55
SP-1-2323	28"	28 1/2"	23"	23"	60
SP-1-2923	34"	28 1/2"	29"	23"	65
SP-1-2929	34"	34 1/2"	29"	29"	70
CUSTOM	OVERALL DIMS.		TUB SIZE		

WT. = Crated shipping weight

Glass & Pot Fillers

332-E35ABCP

Product Type

Single-hole wall-mounted pot and kettle filler

Features & Specifications

- Single hole
- 6" S-type swing spout
- Pressure compensating Softflo aerator 1.5 GPM
- Vandal Proof 2-3/8" lever handle
- Quatum™ compression operating cartridge, right-hand
- ECAST® design provides durable construction with total lead content equal to or less than 0.25% by weighted average
- Complies with the requirements of the Buy American Act of 1933.





Performance Specification

- Rated Operating Pressure: Chicago Faucets No. 332-E35ABCP, Wall Mounted Single Hole Single Water Inlet Faucet, chrome plated. S-Type swing spout, 6" center-to-center. 1.5 GPM (5.7 L/min) pressure compensating Softflo aerator. 2-3/8" metal, vandal-proof, lever handle with sixteen-point, tapered broach and secured, blue index button. Quatum™ rebuildable compression cartridge, opens and closes 90°, closes with water pressure, features square, tapered stem. 1/2" NPT female thread inlet with integral wall flange. ECAST® construction with less than 0.25% lead content by weighted average. CALGreen compliant. This product meets ADA ANSI/ICC A117.1 requirements and is tested and certified to industry standards: ASME A112.18.1/CSA B125.1, California Health and Safety Code 116875 (AB1953-2006), Vermont Bill S.152, NSF/ANSI 372 Low Lead Content, and California Green Building Standards Code (CALGreen).
- Rated Operating Temperature: 40-140°F

Warranty

- 5-Year Limited Cartridge Warranty
- Lifetime Limited Faucet Warranty
- 1-Year Limited Finish Warranty

Codes & Standards

-  ADA ANSI/ICC A117.1
-  ASME A112.18.1/CSA B125.1
-  NSF/ANSI 372 Low Lead Content
- 

Job Name _____

Item Number _____

Section/Tag _____

Model Specified _____

Architect _____

Engineer _____

Contractor _____

Submitted as Shown Submitted with Variations

Date _____



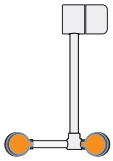
ECAST

ECAST products are intended for installation where state laws and local codes mandate lead content levels or in any location where lead content is a concern.

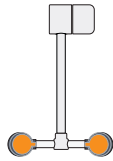
2100 South Clearwater Drive
Des Plaines, IL
P: 847/803-5000
F: 847/803-5454
Technical: 800/TEC-TRUE
www.chicagofaucets.com



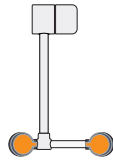
G1849 Eyewash, Deck Mounted, AutoFlow™ 90° Swing-Down



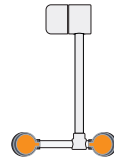
G1849LH-L



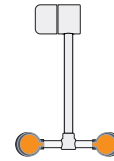
G1849LH



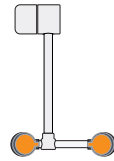
G1849LH-R



G1849L



G1849



G1849R



Application: AutoFlow™ eyewash for mounting on counter. Spray heads swing down from storage to operational position, activating water flow. Available in a variety of spray head configurations to minimize obstructions at a sink. *Note: If unit is not installed at a sink, floor drain should be provided underneath unit to prevent accumulation of water on floor.*

Spray Head Assembly: Two GS-Plus™ spray heads. Each head has a “flip top” dust cover, internal flow control and filter to remove impurities from the water flow.

Valve: 1/2" IPS plug-type valve with PTFE coated O-ring seals. Swinging head assembly down from storage to operational position opens orifice and activates water flow. Unit remains in operation until spray head assembly is returned to storage position.

Strainer: Unit is furnished with in-line strainer to protect valve and spray heads from debris in water line.

Mounting: Valve is installed in chrome plated brass housing. Unit mounts on countertop behind sink. Furnished with mounting hardware for securing unit to counter.

Construction: Polished chrome plated brass.

Supply: 1/2" NPT female inlet.

Sign: ANSI-compliant identification sign.

Quality Assurance: Unit is completely assembled and water tested prior to shipment.

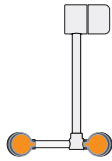
Available Options

G3600LF Thermostatic mixing valve precisely blends hot and cold water to deliver warm (tepid) water as required by ANSI Z358.1-2014. Refer to “Tempering Valves” section for complete technical and product selection information.

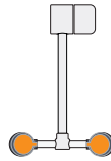




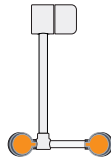
□ G1849 Eyewash, Deck Mounted, AutoFlow™ 90° Swing-Down



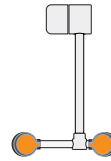
□ G1849LH-L



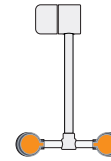
□ G1849LH



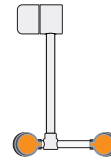
□ G1849LH-R



□ G1849L

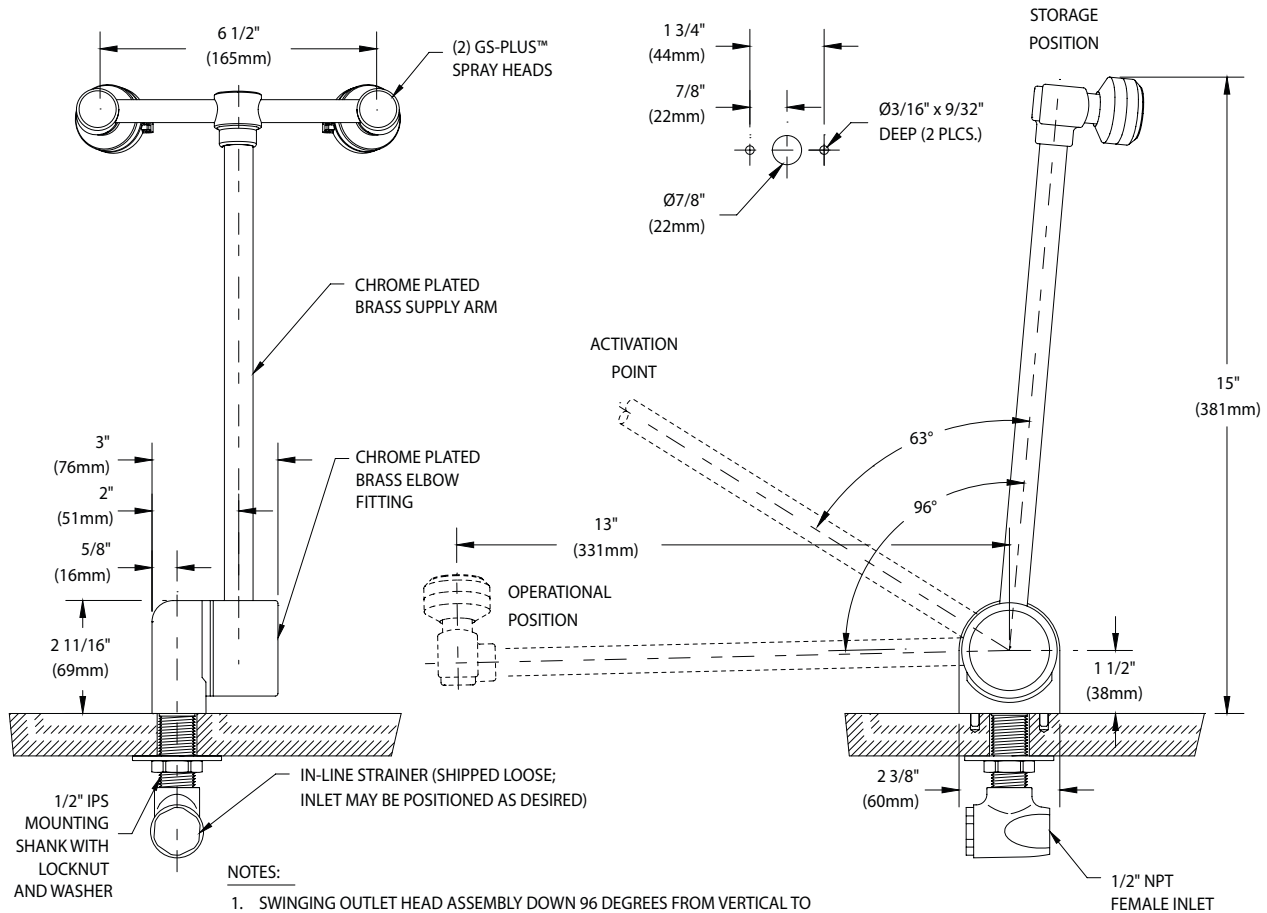


□ G1849



□ G1849R

DETAIL OF MOUNTING PINS



THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Sign Included



Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are ± 1/4" (6mm). rev. 080918





model 1117LN

Barrier-Free Dual Wall Mount Fountain

FEATURES & BENEFITS

INTEGRATED TRAP

All cast brass 1-1/4" NPT adjustable traps completely concealed inside bottom plates for easy installation and lack of unwanted access.

BUBBLER HEAD

Polished chrome-plated brass bubbler head with integral basin shank for added strength. Shielded, angled stream opening provides a steady, sanitary source of drinking water at .45 gpm.

DRINKING FOUNTAIN VALVE

The push-button activated valve offers the only all stainless steel valve body that is machined out of solid bar stock, is fully serviceable through the front of the push button assembly offering access to the water control cartridge and integral water supply strainer, and with front access to the water stream height adjustment for easy maintenance without having to remove the valve. Operating pressure range of 30 to 90 psi (2.1 to 6.2 bar).

CUSTOM LOGO PANEL

Personalize your new or existing fountain or bottle filler where space permits with an optional customizable 10" high by 4.25" wide stainless steel panel. Virtually any company logo, event logo or graphic can be placed on this panel. Mounted with strong, moisture-resistant adhesive backing.

IN-WALL MOUNTING SYSTEM

Install with optional 6700.4 in-wall mounting plate which is 36" wide by 3/16" thick solid steel that spans three studs for a heavy-duty vandal-resistant rigid installation.

CONSTRUCTION

One-piece drinking fountains with low-profile design made of 14 gauge Type 304 stainless steel with 1/4" (.6 cm) thick stainless back plates welded in, and vandal-resistant stainless bottom plates. Satin finish resists stains and corrosion.



SPECIFICATIONS

Model 1117LN low profile Hi-Lo wall-mounted barrier-free drinking fountain shall include dual 14 gauge Type 304 stainless steel satin-finish basins with integral 1/4" (.6 cm) thick stainless steel mounting plates. Push-button operated stainless steel valves with front-accessible cartridge, in-line strainer and flow adjustment provide 100% lead free waterways, polished chrome-plated brass vandal-resistant bubbler heads, polished chrome-plated brass vandal-resistant waste strainers, vandal-resistant bottom plates, stainless steel satin finish back panel, and 1-1/4" NPT concealed all cast-brass traps.

APPLICATIONS

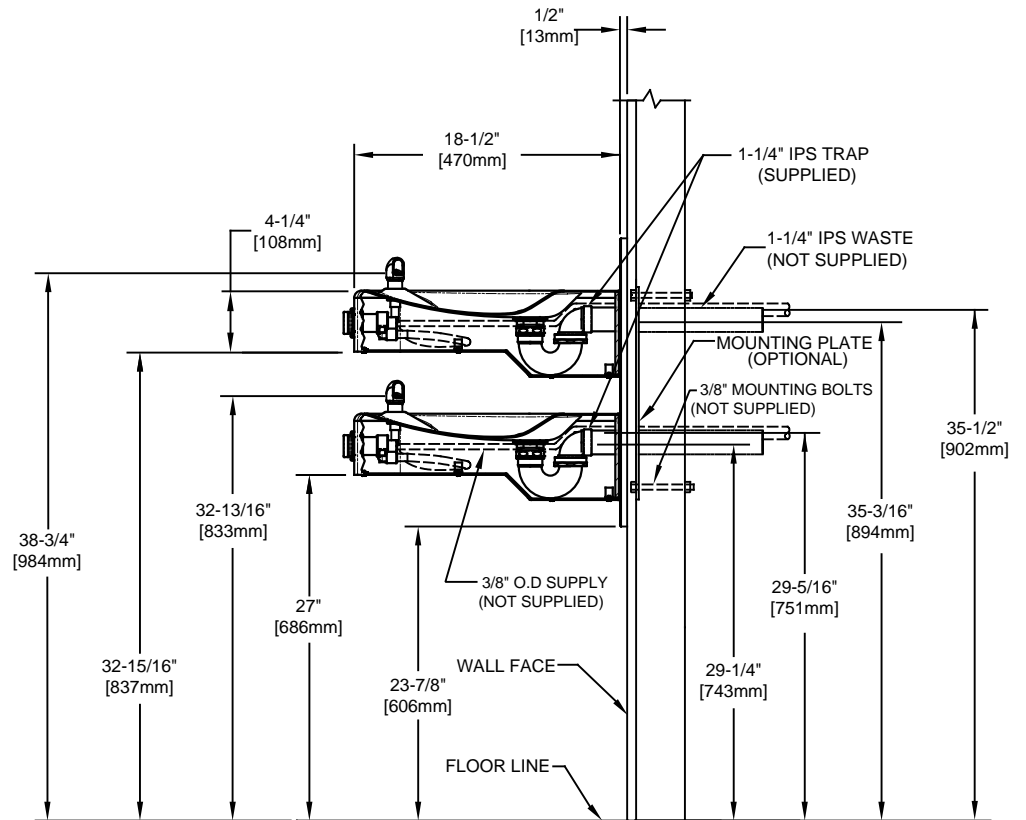
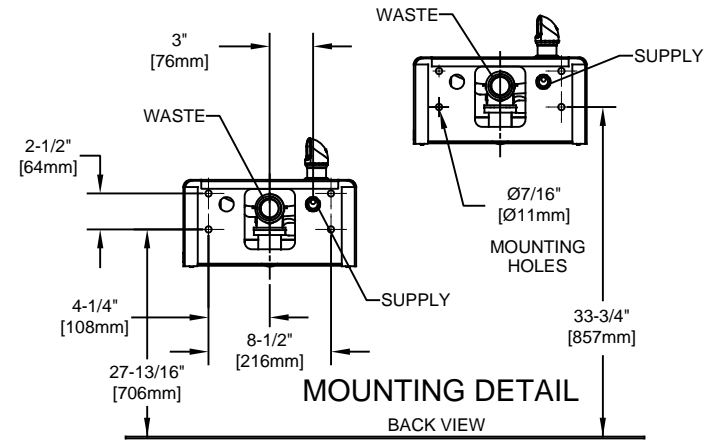
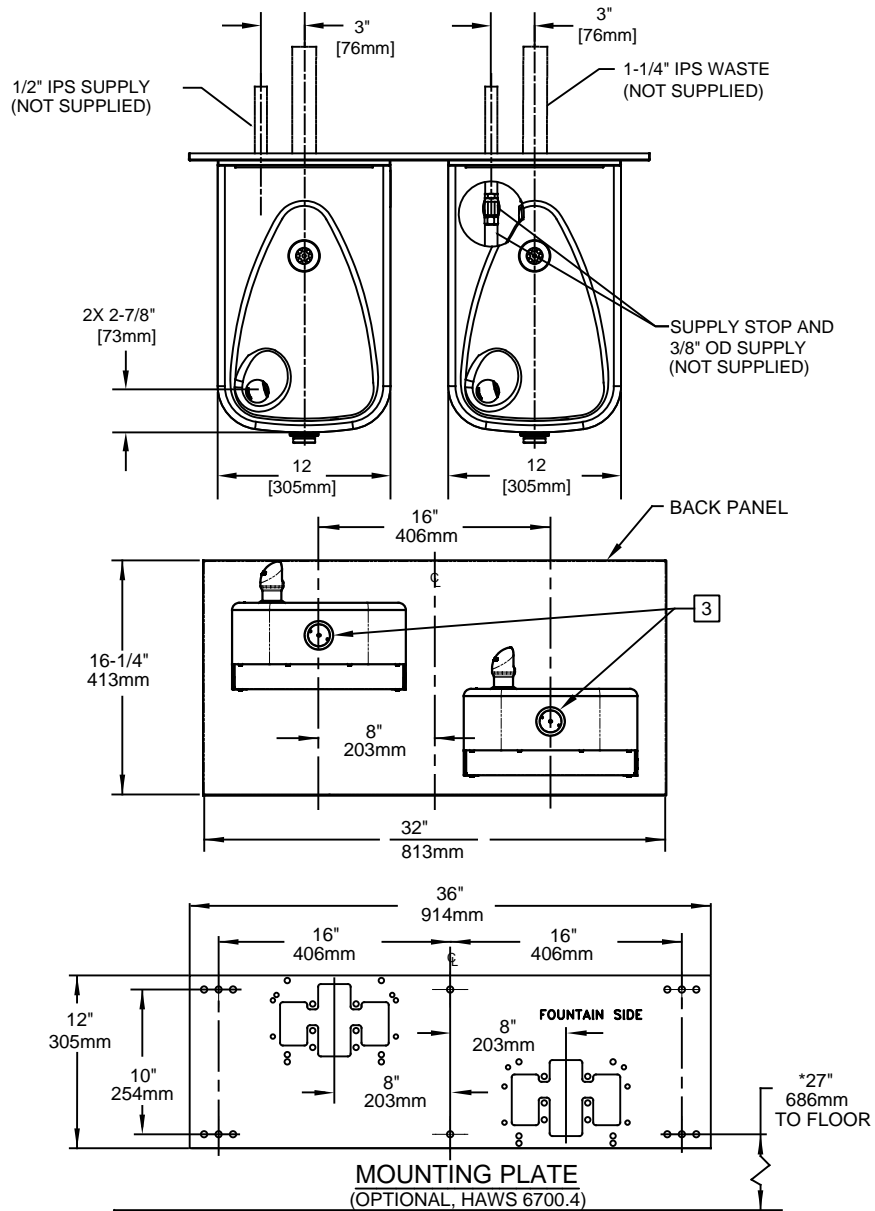
Perfect for either public or private indoor/outdoor settings, Model 1117LN is a great fit in areas where aesthetics are important to the overall appeal of the architecture. Beautiful satin finish helps to maintain the fountains overall appeal. Specifically, this type of wall mounted drinking fountain may be placed in settings such as: schools and other locations in and around office buildings where the temperature remains above freezing. Model meets all current Federal Regulations for the disabled including those in the Americans with Disabilities Act. Haws manufactures drinking fountains and electric water coolers to be lead-free by all known definitions including NSF/ANSI Standard 61, Section 9, NSF/ANSI 372, California Proposition 65, and the Federal Safe Drinking Water Act. Product is compliant to California Health and Safety Code 116875 (AB 1953-2006).

OPTIONS

- ❑ Custom Logo Panel: Model 6475, Hydration By Haws™ logo panel with customization options.
- ❑ Cane Detection, Floor Mounted: Model SK6, floor mounted cane detection for the Haws Hi-Lo drinking fountains.
- ❑ Remote Drinking Fountain Water chiller: Model HCR8, 8 gph (30.3 L) remote water chiller provides instantaneous cooling to meet a continuous demand for chilled water.
- ❑ **Bottle Filler:** Model 1920 stand-alone bottle filling station, or mounted above Haws 1001, 1011, 1107L, 1109, 1117L, and 1119 series drinking fountain models.

For more information, visit www.hawsc.com or call (888) 640-4297.





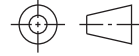
NOTES:

- HOLD ROUGH-IN DIMENSIONS ± 1/8" (3.2mm).
- WHEN INSTALLING THIS UNIT, LOCAL, STATE, OR FEDERAL CODES SHOULD BE ADHERED TO. FOR INSTALLATION HEIGHTS OTHER THAN SHOWN, DIMENSIONS MARKED (*) MUST BE ADJUSTED ACCORDINGLY.
- REFER TO 5874SS/VRK5874 OPERATION AND MAINTENANCE MANUAL FOR PUSH BUTTON AND VALVE INSTALLATION/MAINTENANCE INSTRUCTIONS.

1455 KLEPPE LANE
SPARKS, NEVADA 89431
(775) 359-4712 FAX (775) 359-7424
E-MAIL: HAWS@HAWSCO.COM
WEBSITE: WWW.HAWSCO.COM

ECN NO. 5221	REVISED PER ECN: 5255	BY: JP	MODEL(S) 1117LN	PART NUMBER 058000675.D
DRAWN: GC	DATE: 08/23/17	CHKD.: GC		REVISION 2
APPROVED: FV	DATE: 11/22/17	SCALE: 1:14	DRAWING TYPE: INSTALLATION	SIZE: A SHEET 1 OF 1

Type 478Q Longitudinal ductile iron grate (ADA)



Product Features

- Certified to EN 1433 Load Class E - 135,000 lbs - 2,788 psi
- Uses 'QuickLok' boltless locking system
- Suitable for use with K100, KS100, C100, H100-8, H100-10, H100K-8, H100KS-8, and NW100 channels
- Manufactured from ductile iron to ASTM A 536-84 - Grade 65-45-12
- E- coated for improved resistance against rust
- Complies with ADA - American Disabilities Act of 1990 Section 4.5.4
- Bicycle Tire Penetration Resistant to AS 3996 - 2006



ACO Specification Information

Specifications

General

The surface drainage system shall be ACO Drain K100, KS100, C100, H100-8, H100-10, H100K-8, H100KS-8, and NW100 channels* complete with ACO Type 478Q longitudinal ductile iron grate with 'QuickLok' locking as manufactured by ACO Polymer Products, Inc. or similar approved.

Materials

The covers shall be manufactured from ductile iron and have **minimum** properties as follows:

- **Independently certified to meet Load Class E to EN 1433 - 135,000 lbs - 2,788 psi**
- **Ductile iron to ASTM A 536-84 - Grade 65-45-12**
- **Intake area of 22.5 sq. in. (145.16 cm²) per half meter of grate**

The overall width of 4.85" (123.1mm) and overall length of 19.69" (500mm). Slots measure at a maximum of 0.28" (7mm).

Installation

The trench drain system and grates shall be installed in accordance with the manufacturer's installation instructions and recommendations.

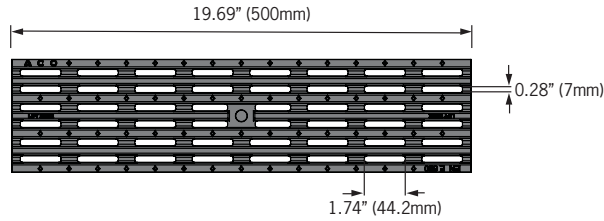
* delete as appropriate

ACO DRAIN

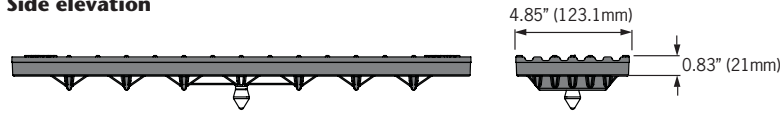
Type 478Q Longitudinal ductile iron grate (ADA)



Plan view

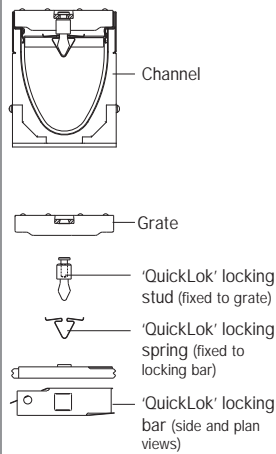


Side elevation



Description	Part No.	Length inches (mm)	Width inches (mm)	Weight lbs.
QuickLok grate				
Type 478Q Ductile iron longitudinal grate	03314	19.69 (500)	4.85 (123.1)	12.8
QuickLok locking bar	02899	-	-	0.5
QuickLok grate removal tool	01318	-	-	0.3

'QuickLok' locking mechanism



ACO 'QuickLok' is a patented boltless locking system, grates are removed and replaced with the minimum time and effort for ease of maintenance. The unique design provides a positive 'snap down' fit into the locking bar. A stud is fixed to the grate which 'locks' into the spring clip in the locking bar.

The 'QuickLok' stud is made from stainless steel and high density nylon, the locking bar and clip are stainless steel, for use in both general purpose and corrosive environments.

ACO Polymer Products, Inc.

Northeast Sales Office
 P.O. Box 245
 Chardon, OH 44024
 Tel: (440) 285-7000
 Toll free: (800) 543-4764
 Fax: (440) 285-7005

West Sales Office
 P.O. Box 12067
 Casa Grande, AZ 85130
 Tel: (520) 421-9988
 Toll Free: (888) 490-9552
 Fax: (520) 421-9899

Southeast Sales Office
 4211 Pleasant Road
 Fort Mill, SC 29708
 Toll free: (800) 543-4764
 Fax: (803) 802-1063

Follow us on

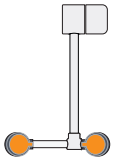
Electronic Contact:
 info@ACODrain.us
 www.ACODrain.us



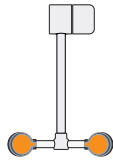
© April 10, 2013 ACO Polymer Products, Inc. This information is believed to be accurate but it is not guaranteed to be so. We cannot assume liability for results that buyer obtains with our product since conditions of use are beyond the control of the company. It is the customer's responsibility to evaluate suitability and safety of product for his own use. ACO Polymer Products Inc. reserves the right to change the product and specifications without notice.



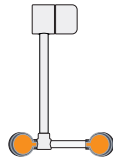
G1849 Eyewash, Deck Mounted, AutoFlow™ 90° Swing-Down



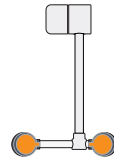
G1849LH-L



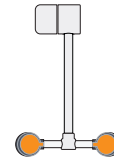
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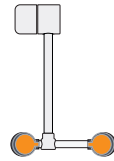
G1849LH-R



G1849L



G1849



G1849R



Application: AutoFlow™ eyewash for mounting on counter. Spray heads swing down from storage to operational position, activating water flow. Available in a variety of spray head configurations to minimize obstructions at a sink. *Note: If unit is not installed at a sink, floor drain should be provided underneath unit to prevent accumulation of water on floor.*

Spray Head Assembly: Two GS-Plus™ spray heads. Each head has a “flip top” dust cover, internal flow control and filter to remove impurities from the water flow.

Valve: 1/2" IPS plug-type valve with PTFE coated O-ring seals. Swinging head assembly down from storage to operational position opens orifice and activates water flow. Unit remains in operation until spray head assembly is returned to storage position.

Strainer: Unit is furnished with in-line strainer to protect valve and spray heads from debris in water line.

Mounting: Valve is installed in chrome plated brass housing. Unit mounts on countertop behind sink. Furnished with mounting hardware for securing unit to counter.

Construction: Polished chrome plated brass.

Supply: 1/2" NPT female inlet.

Sign: ANSI-compliant identification sign.

Quality Assurance: Unit is completely assembled and water tested prior to shipment.

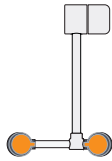
Available Options

G3600LF Thermostatic mixing valve precisely blends hot and cold water to deliver warm (tepid) water as required by ANSI Z358.1-2014. Refer to “Tempering Valves” section for complete technical and product selection information.

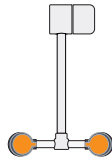




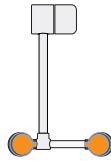
□ G1849 Eyewash, Deck Mounted, AutoFlow™ 90° Swing-Down



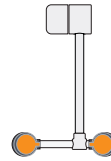
□ G1849LH-L



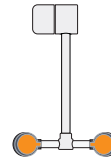
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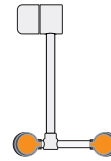
□ G1849LH-R



□ G1849L

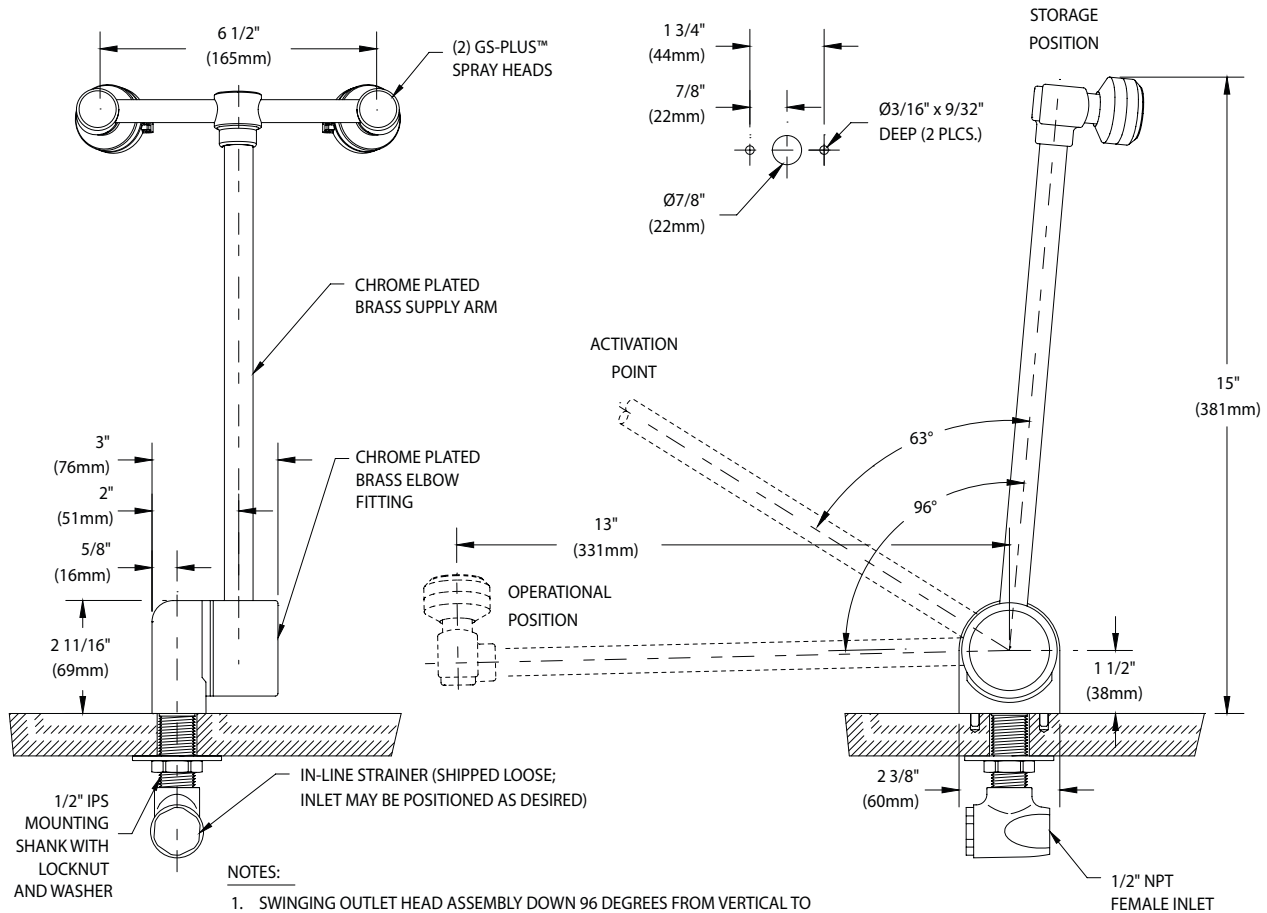


□ G1849



□ G1849R

DETAIL OF MOUNTING PINS



THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL

Sign Included

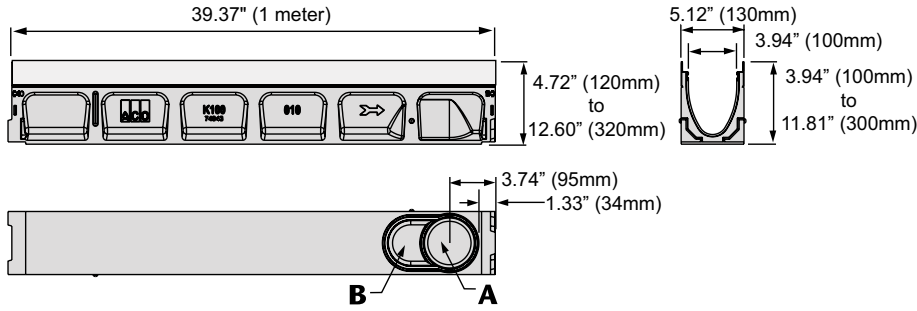


Due to continuing product improvement, the information contained in this document is subject to change without notice. All dimensions are ± 1/4" (6mm). rev. 080918

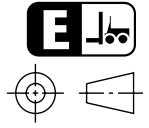


KlassikDrain - K100 Galvanized steel edge rail channel system

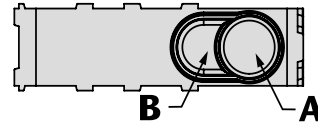
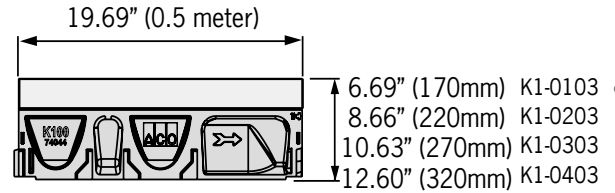
One meter channel



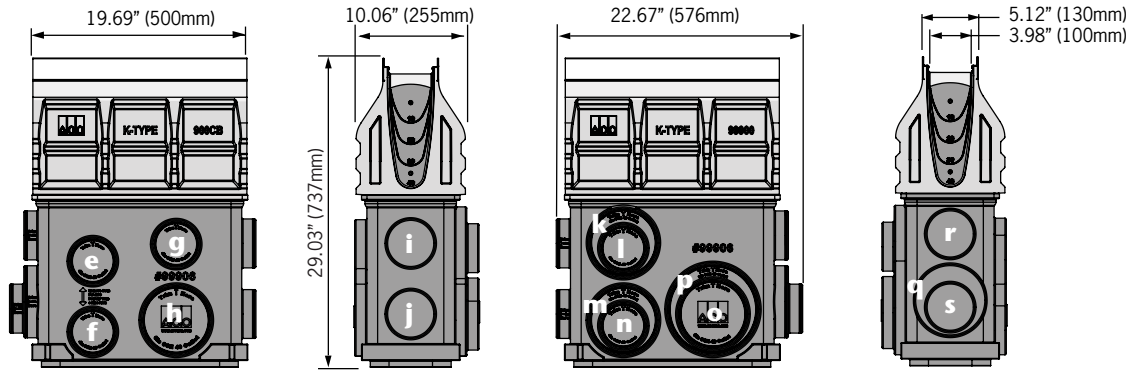
Knock-outs included on every 5th channel



Half meter channel



Type K901G In-line catch basin



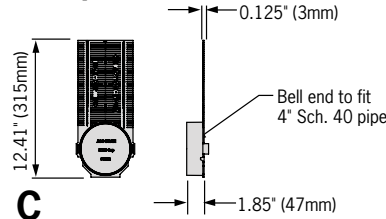
Total capacity = 10.49 gallons

Outlet flow rates

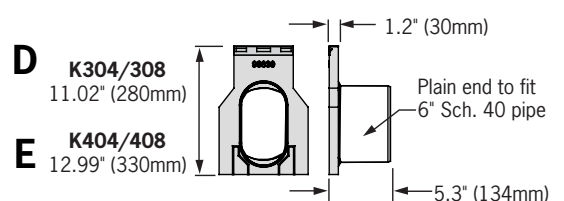
Outlet	Product	Outlet size (Sch. 40)	Invert Depth	GPM	CFS
a	Bottom outlet - K00	4" round	3.94"	108	0.24
a	Bottom outlet - K40	4" round	11.81"	187	0.42
b	Bottom outlet - K00	6" oval	3.94"	177	0.39
b	Bottom outlet - K40	6" oval	11.81"	306	0.68
c	End outlet - K20	4" round	7.87"	132	0.29
c	End outlet - K40	4" round	11.81"	171	0.38
d	K1-308-6 6" outlet cap	6" oval	9.84"	233	0.52
e	K1-408-6 6" outlet cap	6" oval	11.81"	264	0.59
f	Type K1-901G	4" round	19.30"	226	0.50
g	Type K1-901G	4" round	25.67"	265	0.59
h	Type K1-901G	4" round	25.30"	263	0.59
i	Type K1-901G	4" round	18.56"	222	0.49
j	Type K1-901G	6" round	25.85"	586	1.30
k	Type K1-901G	4" round	26.43"	269	0.60
l	Type K1-901G	4" round	19.36"	227	0.51
m	Type K1-901G	6" round	27.30"	604	1.35
n	Type K1-901G	6" round	19.99"	505	1.12
o	Type K1-901G	6" round	26.43"	593	1.32
p	Type K1-901G	8" round	27.30"	1051	2.34
q	Type K1-901G	4" round	27.17"	273	0.61
r	Type K1-901G	4" round	20.68"	235	0.52
s	Type K1-901G	4" round	18.99"	224	0.50
t	Type K1-901G	6" round	27.17"	6.02	1.34

Note: These are the pipe flow rates at the specified outlet, NOT channel flow rates. Catch basin flow rates are without trash bucket - using trash bucket reduces flow.

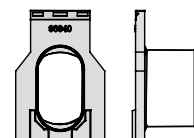
End Cap



6" Oval inlet cap



6" Oval outlet cap



KlassikDrain - K100 Galvanized steel edge rail channel system



ACO Specification Information

Description	Part No.	Invert		Weight Lbs.
		Inches ²	mm ²	
K1-00 Neutral channel - 39.37" (1m)^D	74041	3.94	100	28.1
K1-1 Sloped channel - 39.37" (1m)	74001	4.13	105	28.1
K1-2 Sloped channel - 39.37" (1m)	74002	4.33	110	28.9
K1-3 Sloped channel - 39.37" (1m)	74003	4.53	115	29.7
K1-4 Sloped channel - 39.37" (1m)	74004	4.72	120	30.5
K1-5 Sloped channel - 39.37" (1m) ^Q	74005	4.92	125	31.3
K1-6 Sloped channel - 39.37" (1m)	74006	5.12	130	32.1
K1-7 Sloped channel - 39.37" (1m)	74007	5.31	135	32.9
K1-8 Sloped channel - 39.37" (1m)	74008	5.51	140	33.7
K1-9 Sloped channel - 39.37" (1m)	74009	5.71	145	34.5
K1-10 Sloped channel - 39.37" (1m) ^D	74010	5.91	150	35.3
K1-010 Neutral channel - 39.37" (1m)^D	74043	5.91	150	35.3
K1-0103 Neutral channel - 19.69" (0.5m)^D	74044	5.91	150	17.0
K1-11 Sloped channel - 39.37" (1m)	74011	6.10	155	36.1
K1-12 Sloped channel - 39.37" (1m)	74012	6.30	160	36.9
K1-13 Sloped channel - 39.37" (1m)	74013	6.50	165	37.7
K1-14 Sloped channel - 39.37" (1m)	74014	6.69	170	38.5
K1-15 Sloped channel - 39.37" (1m) ^D	74015	6.89	175	39.3
K1-16 Sloped channel - 39.37" (1m)	74016	7.09	180	40.1
K1-17 Sloped channel - 39.37" (1m)	74017	7.28	185	40.9
K1-18 Sloped channel - 39.37" (1m)	74018	7.48	190	41.7
K1-19 Sloped channel - 39.37" (1m)	74019	7.68	195	42.5
K1-20 Sloped channel - 39.37" (1m) ^D	74020	7.87	200	43.4
K1-020 Neutral channel - 39.37" (1m)^D	74045	7.87	200	43.4
K1-0203 Neutral channel - 19.69" (0.5m)^D	74046	7.87	200	20.5
K1-21 Sloped channel - 39.37" (1m)	74021	8.07	205	44.2
K1-22 Sloped channel - 39.37" (1m)	74022	8.27	210	45.0
K1-23 Sloped channel - 39.37" (1m)	74023	8.46	215	45.8
K1-24 Sloped channel - 39.37" (1m)	74024	8.66	220	46.6
K1-25 Sloped channel - 39.37" (1m) ^D	74025	8.86	225	47.4
K1-26 Sloped channel - 39.37" (1m)	74026	9.06	230	48.2
K1-27 Sloped channel - 39.37" (1m)	74027	9.25	235	49.0

Description	Part No.	Invert		Weight Lbs.
		Inches ²	mm ²	
K1-28 Sloped channel - 39.37" (1m)	74028	9.45	240	49.8
K1-29 Sloped channel - 39.37" (1m)	74029	9.65	245	50.6
K1-30 Sloped channel - 39.37" (1m) ^Q	74030	9.84	250	51.4
K1-030 Neutral channel - 39.37" (1m)^D	74047	9.84	250	51.4
K1-0303 Neutral channel - 19.69" (0.5m)^D	74048	9.84	250	24.0
K1-31 Sloped channel - 39.37" (1m)	74031	10.04	255	52.2
K1-32 Sloped channel - 39.37" (1m)	74032	10.24	260	53.0
K1-33 Sloped channel - 39.37" (1m)	74033	10.43	265	53.8
K1-34 Sloped channel - 39.37" (1m)	74034	10.63	270	54.6
K1-35 Sloped channel - 39.37" (1m) ^D	74035	10.83	275	55.4
K1-36 Sloped channel - 39.37" (1m)	74036	11.02	280	56.2
K1-37 Sloped channel - 39.37" (1m)	74037	11.22	285	57.0
K1-38 Sloped channel - 39.37" (1m)	74038	11.42	290	57.9
K1-39 Sloped channel - 39.37" (1m)	74039	11.61	295	58.7
K1-40 Sloped channel - 39.37" (1m) ^D	74040	11.81	300	59.5
K1-040 Neutral channel - 39.37" (1m)^D	74049	11.81	300	59.5
K1-0403 Neutral channel - 19.69" (0.5m)^D	74050	11.81	300	27.5
K1-901G In-line catch basin - 19.69" (0.5m) ^D	94608	28.81	701.9	52.6
K1-621G catch basin - 19.69" (0.5m) ^D	94617	28.84	732.5	55.8
K1-631G catch basin - 19.69" (0.5m) ^D	94631	40.84	1037.4	65.8
K1-Series 600 Optional plastic riser	99902	-	-	10.0
Foul air trap - fits both 900 & 600 series basins	90854	-	-	1.2
K1-304-6 6" Inlet Cap	96839	9.84	250	5.2
K1-308-6 6" Outlet Cap	96840	9.84	250	5.0
K1-404-6 6" Inlet Cap	96834	11.81	300	6.0
K1-408-6 6" Outlet Cap	96836	11.81	300	5.8
Universal end cap	96822	11.81	300	0.4
Debris strainer for 4" bottom knockout	93488	-	-	0.2
4" Oval to 6" round outlet adapter	95140	-	-	1.1
K1-Installation device	97477	-	-	2.8
Grate removal tool	01318	-	-	0.3
K1-QuickLok locking bar	02899	-	-	0.1

Notes:

1. This channel offers a bottom knockout feature; 4" round/6" oval.
2. Inverts shown are for the male end; for female invert depth subtract 5mm (=0.2") from the male invert (except for neutral channels, where it will be same as male invert).
To calculate the overall channel depth add 20mm (=0.8") to invert depth.
3. This catch basin kit includes a polymer concrete top, removable QuickLok locking bar, trash bucket and plastic base. Select an appropriate grate.
4. This catch basin kit includes a polymer concrete top, removable QuickLok locking bar, deep trash bucket, plastic riser and plastic base. Select an appropriate grate.

Specifications	
General The surface drainage system shall be ACO Drain K100 complete with gratings secured with 'QuickLok' locking as manufactured by ACO, Inc. or approved equal.	Water absorption 0.07% Frost proof YES Salt proof YES Dilute acid and alkali resistant YES
Materials The trench system bodies shall be manufactured from polyester polymer concrete with the minimum properties as follows: Compressive strength: 14,000 psi Flexural strength: 4,000 psi	The nominal clear opening shall be 4" (100mm) with overall width of 5.12" (130mm). Pre-cast units shall be manufactured with either an invert slope of 0.5% or with neutral invert and have a wall thickness of at least 0.50" (13mm). Each unit will feature a partial radius in the trench bottom and a male to female interconnecting end profile. Units shall have horizontal cast in anchoring keys on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and pavement surface. The galvanized steel edge rail will be integrally cast in by the manufacturer to ensure maximum homogeneity between polymer concrete body and edge rail. Each edge rail shall be at least 3/32" (2.5mm) thick.
Grates Grates shall be specified. See separate ACO Spec Info grate sheets for details. After removal of gratings and 'QuickLok' bar there shall be uninterrupted access to the trench to aid maintenance.	
Installation The trench drain system shall be installed in accordance with the manufacturer's installation instructions and recommendations.	

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SECTION 23 0000

HEATING, VENTILATING, AIR CONDITIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The requirements of the General Conditions, Supplemental General Conditions, Division 01 Sections and Section 23 0500 - General Mechanical apply to all work herein.
- B. Section includes furnishing and installation of complete "Heating, Ventilating, Air Conditioning" systems, including but not necessarily limited to the following:
 - 1. Split system heat pump units;
 - 2. Split system fan coil units, cooling only;
 - 3. Refrigerant piping and appurtenances;
 - 4. Ceiling mounted and duct mounted exhaust fans;
 - 5. Energy recovery ventilator;
 - 6. Gravity relief ventilators;
 - 7. Thermal and sound insulation for all piping and ductwork supplied under this Section;
 - 8. Ductwork, inclusive of all air turns, dampers, grilles, diffusers, supports, bracing and outside air ducts;
 - 9. Flashings, curbs and caps in connection with all equipment, piping and ductwork supplied under this Section;
 - 10. Testing, adjusting and balancing of systems;
 - 11. Equipment start-up.
- C. Related Sections
 - 1. See Section 07 6200 for sheet metal flashing and trim
 - 2. See Section 09 000 for finish painting
 - 3. See Section 22 0000 for related plumbing
 - 4. See Section 23 0500 for general mechanical
 - 5. See Section 23 0593 for testing, adjusting and balancing HVAC
 - 6. See Section 23 0923 for controls for HVAC
 - 7. See Section 26 0000 for basic electrical requirements
 - 8. See Section 26 0500 for basic materials and methods
- D. The Contractor shall furnish all materials and labor under the scope of the Contract, unless otherwise noted. Anything accepted as standard trade practice reasonably incidental to the completion of the system shall be furnished without additional cost to the Owner. The Contractor shall understand that the work herein described shall be complete in every detail, notwithstanding every item necessarily involved is not particularly mentioned, and the Contractor shall be held to provide all labor and material necessary for the entire completion of the work.
- E. Comply with applicable requirements in ASHRAE 62.1 and ASHRAE 90.1

1.2 SUBMITTALS

- A. All submittals shall be submitted under the provisions of Section 01 3300 and Section 23 0500 - General Mechanical.
- B. Product Data

1. For all HVAC equipment, include manufacturer's specifications and data sheets, and certified drawings on major equipment. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, and accessories.
- C. Coordinated Layout/Shop Drawings
1. Prepare complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Shop drawings shall be prepared using AutoCAD 2014 or newer and shall be drawn at a minimum $\frac{1}{4}'' = 1' - 0''$ scale.
 2. All drawings shall be fully coordinated with HVAC, Plumbing, Fire Protection, Electrical, Structural, and Architectural work. Drawings shall be coordinated and dimensioned indicating equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Indicate exact locations of valves, piping specialties, access doors, etc.
 3. Clearly identify and dimension the proposed locations of the principal items of equipment and adequate clearance for all equipment, piping, pumps, valves and other items. Provide detailed layout of all piping systems showing the proposed routes.
 4. Show the access means for all items requiring access for operations and maintenance.
 5. Submit shop drawings to Architect for approval, prior to fabrication or installation of any work. Do not install equipment or piping until drawings have been approved. Any work installed without prior shop drawing approval shall be removed at the Contractor's expense.
 6. Use of contract documents for shop drawings is not acceptable.
- D. Shop-wiring diagrams of temperature controls and air conditioning unit controls.
- E. Equipment manufacturer shall design, construct, and certify that his equipment satisfies the special minimum seismic resistance requirements for this project and shall submit calculations or test results supporting his certification.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data
1. Contractor shall provide all operating and maintenance instructions provided by the manufacturer, describing proper operation and maintenance of any equipment and devices installed. Operating and maintenance instructions shall cover maintenance, adjustment, and operation of each piece of apparatus.
 2. Contractor shall also provide a parts list of all equipment and component parts for all equipment under this Section. The equipment list shall include manufacturer's name, model number, and local representative, service facilities and normal channel of supply for each item.
 3. Data shall include a table of contents identifying items therein, and index tabs for each system. Neatly obscure or cross out inapplicable data from manufacturer's literature. Include the following:
 - a. Manufacturer's brochures, ratings, certified shop drawings, lubrication charts and data, and parts list with part numbers. Mark each sheet with equipment identification number and actual installed condition or system and location of installation. Specifically identify which options are provided.
 - b. Description of start-up and operating procedures for each system, including controls diagrams and description of operating sequences.
 - c. Recommend preventative maintenance schedule and procedures.
 4. Provide copies of all test documents in the O&M manual.
 5. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, and UL listings. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

6. Submit data to the Architect for approval. Final acceptance of the work will not be made until a satisfactory submission of this material is received and approved by the Architect.

H. As-built Drawings

1. Complete and detailed shop drawings shall be maintained throughout the coordination and construction phase, indicating all equipment and trades' work clearly. All equipment including piping, etc. shall clearly identify both top and bottom elevations as well as distances from equipment to established building lines. Coordinate with other trades and field conditions and show dimensions and details including building construction and access for servicing. All changes in the work shall be recorded on this set on a daily basis. In addition to changes made during course of work, show the following:
 - a. Exact location, type and function of concealed valves and controllers.
 - b. Exact size, elevations and location of underground and under floor piping.
2. Submit to Architect for approval.

I. Warranty

1. Equipment warranties shall be provided for all equipment, with all necessary information filled in, except purchase date, in favor of the Owner.

J. Refer to mechanical equipment specified herein for additional requirements

1.3 DEMONSTRATION & TRAINING

- A. The Owner's authorized representative shall be instructed in the operation and servicing of all heating, ventilating, and air conditioning systems, subsystems and equipment.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations. Provide a minimum of one day of instruction time. All instruction shall be provided at no cost to the Owner.

1.4 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. Hazardous Materials:
 1. Comply with local, State of California, and Federal regulations relating to hazardous materials.

2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract

PART 2 - - PRODUCTS

2.1 REFRIGERANT PIPING AND APPURTENANCES

- A. Refrigerant piping shall be Type "ACR" ASTM B 280, drawn temper, seamless copper tube.
- B. Pipe fittings and unions shall be wrought-copper with brazed joints. ASME B16.22. Mechanical joints on refrigerant piping are prohibited. All refrigerant piping joints shall be brazed. Lead-free silver brazing alloy, minimum 15% silver content. Harris "Stay Silv 15" or equal.
- C. Flexible connectors shall be bronze, double braided, with inlet and outlet connections as required. Metraflex BBS series or equal.
- D. Sight glasses shall be color change moisture indication type, replaceable element, filter screen and pad, sweat solder ends; Sporlan "See-All", or equivalent Henry or Parker Hannifin.
- E. Charging and purge valves shall be forged brass, diaphragm packless, globe type, angle or straight through, one end solder, one end flare; Henry 623 and 643 series, or equivalent Hansen or Flomatic.
- F. Solenoid valves shall be of forged brass, extended solder end connections, molded coil; Sporlan "E" series, equivalent Hansen, or approved equal. ARI 760 & UL 429
- G. Filter driers shall be UL listed, replaceable core type, steel shell with removable cap, Sporlan, Parker Hannifin or Emerson Flow Controls.
- H. Electronic thermostatic expansion valves shall have stainless steel body and connections, ceramic slide and port, linear flow capacity, continuous modulation, and direct coupling of motor and valve; Emerson "EX" series or equal.
- I. Pipe hangers: All refrigerant piping shall be supported 8' on center. Hangers and supports shall be as specified in Section 23 0500 - General Mechanical".

2.2 DUCT MOUNTED INLINE EXHAUST FANS (DIRECT DRIVE) SQ

- A. Greenheck "SQ" series, model SQ-60VG6G, as scheduled on the Drawings or approved equal. The duct mounted exhaust fans shall be of the centrifugal, direct drive in-line type. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
- B. Fan Wheel
 1. The fan wheel shall be non-overloading centrifugal backward inclined type, constructed of aluminum, and shall include a wheel cone matched to the inlet cone for precise running tolerances.
 2. Wheels shall be dynamically and statically balanced according to AMCA Standard 204-05.
 3. The fan wheel shall have single thickness blades securely riveted or welded to a heavy gauge back plate and wheel cone.
- C. Electronically Commutated Motors (Varigreen)

1. The motor enclosures shall be open type.
 2. The motor shall be a DC electronic commutation type (ECM) specifically designed for fan applications.
 3. Motors shall be permanently lubricated, heavy duty ball bearing type to match the fan load and pre-wired to the specified voltage and phase.
 4. Internal motor circuitry shall convert the AC power supplied to the fan to DC power to operate the motor.
 5. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 6. Motor shall be a minimum of 85% efficient at all speeds.
- D. Housing/Cabinet Construction
1. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
 2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel. Housing supports shall have formed flanges. Drive frame shall be welded steel to support the motor.
- E. Disconnect switches shall be NEMA 1 rated, have positive electrical shut-off, and shall be wired from fan motor to junction box.
- F. Duct collars shall be square design to provide a large discharge area. Inlet and discharge collars shall be provided for easy duct connection.
- G. Access panels shall be two-sided to permit easy access to all internal components. Panels shall be located perpendicular to the motor mounting panel.
- H. Provide with MERV 13 filter option.

2.3 CEILING MOUNTED EXHAUST FANS

- A. Greenheck "SP-AP" series, model SP-AP0511W, modular ceiling mounted ceiling exhaust fans, as scheduled on the Drawings, or approved equal. Fans shall be Energy Star certified.
- B. The fans shall have virtually silent "EC" motor and (3) built-in high speed airflow settings of 50, 80 and 110 cfm. Constant cfm technology shall provide guaranteed airflow to over .375 in. wg. Standard two speed operation shall provide tools to help meet ASHRAE 62.2 and California Title 24 requirements. Fans shall include a universal duct connector for connections to 4", 5" and 6" duct.
- C. Accessories: Plug and play motion sensor.

2.4 ENERGY RECOVERY VENTILATOR

- A. Energy Wall "U-ERV 600" series, as scheduled on the Drawings or approved equal.
- B. The ventilator shall utilize an "Energy Filter" fixed plate heat exchanger for heat and moisture transfer, counterflow type, . The heat exchanger shall have an anti-microbial, patented ceramic membrane. There shall be zero cross contamination
- C. The fan motor shall be ECM type, with fully variable speed modulation. Variable airflow adjustability and balancing shall be done with mechanical turn potentiometer. Remote variable airflow adjustability shall be via a 0-10V signal.

- D. The exterior shell shall be corrosion and chemical proof polypropylene, double wall construction and shall be insulated with nano-particle metal oxide insulation.
- E. The unit shall come with a UL98 rated non-fused disconnect.

2.5 GRAVITY RELIEF VENTILATOR

- A. Greenheck model GRSR relief gravity ventilator, as scheduled on the Drawings, or approved equal.
- B. Hood shall be constructed of aluminum. Internal structure shall be constructed of galvanized steel. Birdscreen shall be constructed of ½ inch galvanized mesh and mounted horizontally across the intake area of the hood.
- C. Housing shall be constructed of aluminum, including windband and curb cap. Windband shall be one piece spun aluminum construction and maintain original material thickness throughout the housing. Windband shall include an integral rolled bead for strength. Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to roof.
- D. Each unit shall bear a permanently affixed manufacture's nameplate containing the model number and individual serial number
- E. Options / Accessories
 - 1. Insulated roof curb, to be mounted onto roof with fan.
 - 2. Insect screen constructed of fine mesh aluminum and fitted to the top of the throat to prevent entry of insects.

2.6 AIR TERMINALS

- A. All terminals shall be steel and shall be factory painted. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- B. The manufacturer shall provide published performance data for the diffusers and grilles. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
- C. Air terminals for installation in gypsum board shall have a 1" border for surface mounting. All air terminals for installation in lay in ceilings shall have a lay in frame to match the specified grid system
 - 1. Ceiling Diffusers (CD) and Ceiling Return (CR), Square, Rectangular or Round Neck - High Capacity
 - a. Ceiling diffusers shall be Titus model TDC (steel) fixed, horizontal discharge pattern, as scheduled on the Drawings or equal. A square or rectangular inlet shall be an integral part of the frame assembly and a transition piece shall be available to facilitate attachment of round duct. An inner core assembly consisting of fixed deflection louvers shall be available in one-, two-, three- or four-way horizontal discharge patterns. The inner core assembly must be removable in the field without tools for easy installation, cleaning or damper adjustment.
 - 2. Wall Supply Diffusers (WS)
 - a. Steel supply grilles shall be Titus model 300RL (double deflection), as scheduled on the Drawings or approved equal. The deflection blades shall be available parallel to

- the long dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.
- b. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be spaced on ¾-inch centers. Blades shall have steel friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Plastic blade pivots are not acceptable.
3. Duct Supply Grille (DS), Double Deflection
 - a. Aluminum supply grilles shall be Titus direct spiral duct-mounted supply grilles model S300FL (double deflection) as scheduled on the Drawings or approved equal. The deflection blades shall be available parallel to the long or short dimension of the grille. All supply grilles shall be constructed with radius end caps and foam gaskets for a tight seal to the duct diameter. All supply grilles shall be constructed with a 1 3/8-inch wide border.
 - b. Blades shall be constructed of heavy-duty extruded aluminum and shall be spaced ¾-inch apart. Blades shall extend completely through the side frame on each side to ensure stability throughout the complete cfm operating range of the grille. Blades shall be individually adjustable without loosening or rattling and shall be securely held in place with tension wire.
 4. Door Louvers (DL)
 - a. Door louvers shall be Titus model T700, as scheduled on the Drawings or approved equal. Construction shall be of steel with a 1¼-inch border width. The border and blades shall be of 20-gauge steel. Inverted V-blades with a deflection angle of 77° shall be used to create a sight proof design and provide additional stiffness to the grille. Corners shall be welded with full penetration resistance welds with a reinforcing patch. Screw holes shall be countersunk.

2.7 SPLIT SYSTEM OUTDOOR UNIT (COOLING ONLY)

- A. The heat pump/cooling only system outdoor unit shall be Mitsubishi model PUZ-A24NHA7, as scheduled on the Drawings or approved equal. The system shall consist of a horizontal discharge, single phase outdoor unit and (2) one-half capacity indoor units. The outdoor unit shall be completely factory assembled, piped, and wired. The unit shall be pre-charged for a maximum of 70 feet of refrigerant tubing. Each unit must be test run at the factory.
- B. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions. The outdoor sound level shall not exceed 47 dB(A) for cooling and 48 dB(A) for heating.
- C. Cabinet
 1. The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish.
 2. Mounting feet shall be provided and shall be welded to the base of the cabinet.
 3. Panel sections shall be removable.
 4. The fan grill shall be of ABS plastic.
- D. Fan
 1. The unit shall be furnished with a single DC fan motor.
 2. The fan blade(s) shall be of aerodynamic design. Fan motor bearings shall be permanently lubricated.
 3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.
- E. Coil

1. The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.
2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor-controlled step motor.
3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ACR Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a - Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

F. Compressor

1. The compressor for shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive technology.
2. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.
3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.
4. The outdoor unit shall have an accumulator and high-pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical

1. The electrical power of the unit shall be 208 volts, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
2. Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using (3) 14 gauge AWG conductors plus ground wire connecting the units.
3. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
4. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
5. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

- H. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.

2.8 SPLIT SYSTEM INDOOR UNIT - WALL MOUNTED TYPE

- A. Mitsubishi model PKA-A12HA7, as scheduled on the Drawings or approved equal. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- B. Unit Cabinet: The cabinet shall be wall mounted by means of a factory supplied mounting plate. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required. The cabinet shall be formed from high strength molded plastic with front panel access for filter. Cabinet color shall be white.

- C. Fan: The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right). A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- D. Filter: Return air shall be filtered by means of an easily removable washable filter.
- E. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory.
- F. Electrical: The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall be supplied from the outdoor unit, using the Mitsubishi Electric A-Control system. For A-Control, a 3-conductor AWG-14/16 wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.
- G. System Control:
 - 1. The control system shall consist of a minimum of 2 microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
 - 2. For A-Control, a 3-conductor 14-gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.
 - 3. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time.

2.9 OUTDOOR HEAT PUMP UNIT

- A. Mitsubishi "City Multi VRF, R2 series" outdoor unit, model PURY-EP72TNU-A, as scheduled on the Drawings or approved equal.
- B. General
 - 1. The PURY outdoor unit shall be used specifically with CITY MULTI VRF components. The outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
 - 2. The unit shall require factory-supplied twinning kits for the indoor units to be piped together in the field without the need for equalizing line(s). Required Accessory for Combining Indoor Units: MSDD-50TR-E
 - 3. Outdoor unit shall have a sound rating no higher than 64 dB(A) twinned. Units shall have a sound rating no higher than 53 dB(A) twinned while in night mode operation.
 - 4. Both refrigerant lines from the PURY outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
 - 5. The outdoor unit shall have an accumulator with refrigerant level sensors and controls, a high-pressure safety switch, over-current protection, crankcase heater and DC bus protection.

6. The outdoor units shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 7. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend “no or reduced heating” periods shall not be allowed.
- C. Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
- D. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 inches WG external static pressure, but capable of normal operation under a maximum of 0.24 inches WG external static pressure via dipswitch.
 2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 3. All fan motors shall be mounted for quiet operation.
 4. All fans shall be provided with a raised guard to prevent contact with moving parts.
 5. The outdoor unit shall have vertical discharge airflow.
- E. Refrigerant: R410A refrigerant shall be required for the outdoor unit systems. Polyolester (POE) oil shall be required.
- F. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
 3. The coil shall be protected with an integral metal guard.
 4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
 5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.
- G. Compressor:
1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
 2. A crankcase heater(s) shall be factory mounted on the compressor(s).
 3. The outdoor unit compressor shall have an inverter to modulate capacity.
 4. The compressor will be equipped with an internal thermal overload.
 5. The compressor shall be mounted to avoid the transmission of vibration.
 6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
- H. Controls
1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system
- I. Electrical:
1. The outdoor unit shall be controlled by integral microprocessors.
 2. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.10 SPLIT SYSTEM INDOOR UNIT (WALL MOUNTED)

- A. Mitsubishi "City Multi R-2 series" model PKFY-P06NBMU-E2R1, as scheduled on the Drawings or approved equal. The PKFY shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The unit shall be used with the R2-Series outdoor unit and BC Controller. The unit shall support individual control using M-NET DDC controllers.
- B. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
 - 1. All casings shall have the same white finish.
 - 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
 - 3. There shall be a separate back plate which secures the unit firmly to the wall.
- D. Fan:
 - 1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
 - 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 - 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 - 4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter: Return air shall be filtered by means of an easily removable, washable filter.
- F. Coil:
 - 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - 2. The tubing shall have inner grooves for high efficiency heat exchange.
 - 3. All tube joints shall be brazed with phos-copper or silver alloy.
 - 4. The coils shall be pressure tested at the factory.
 - 5. A condensate pan and drain shall be provided under the coil.
 - 6. Both refrigerant lines to the PKFY indoor units shall be insulated.
- G. Controls:
 - 1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system.
 - 2. The unit shall be able to control external backup heat.
 - 3. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
 - 4. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
 - 5. Indoor unit shall include no less than 4 digital inputs capable of being used for customizable control strategies.
 - 6. Indoor unit shall include no less than 3 digital outputs capable of being used for customizable control strategies.

2.11 SPLIT SYSTEM INDOOR UNIT (DUCTED)

- A. Mitsubishi "City Multi R-2 series", model PEFYP15NMAU-E3, as scheduled on the Drawings or approved equal. The ceiling-concealed ducted indoor fan coil shall mount above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY shall be used with the R2-Series outdoor unit and BC Controller. The PEFY shall support individual control using M-NET DDC controllers.
- B. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet: The cabinet panel shall have provisions for a field installed filtered outside air intake.
- D. Fan:
 - 1. The fan shall be an assembly with one Sirocco fan direct driven by a single motor.
 - 2. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - 3. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
 - 4. The indoor unit shall have a ducted air outlet system and ducted return air system.
- E. Filter:
 - 1. Return air shall be filtered by means of a standard factory installed return air filter.
 - 2. Optional return filter box (rear or bottom placement) with high-efficiency filter shall be available for all PEFY indoor units.
- F. Coil:
 - 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 - 2. The coils shall be pressure tested at the factory.
 - 3. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil.
 - 4. Both refrigerant lines to the PEFY indoor units shall be insulated.

2.12 SPLIT SYSTEM INDOOR UNIT (MULTI-POSITION AIR HANDLER)

- A. Mitsubishi "City Multi R-2 series", model PVFYP48NAMU-E1, as scheduled on the Drawings or approved equal. The indoor unit shall be a multi-position fan coil design with a fixed bottom return, a fixed vertical discharge supply, and a modulating linear expansion device. The unit shall have the capability to be mounted in either the vertical or horizontal (left or right) and have the capability to integrate into systems with various types of indoor units connected. The PVFY shall be used with the R2-Series outdoor unit and BC Controller.
- B. The indoor unit shall support individual control using M-NET DDC controllers. Units shall have the ability to control supplemental heat or humidifier via a control board connector and a 12 VDC output. Units shall have ability to output fan speed via a relay kit.
- C. The PVFY shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition. The PVFY shall be tested in accordance with ANSI/ASHRAE 193 and have less than 2% air leakage at maximum airflow setting.

- D. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- E. Unit Cabinet: The cabinet shall be pre-painted, pre-insulated, 22 gauge galvanized steel.
- F. Fan:
 - 1. The indoor unit fan shall be an assembly with a single direct drive fan with a high efficiency DC motor.
 - 2. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - 3. The indoor unit shall have a ducted air outlet system and ducted return air system.
 - 4. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.W.G. selectable.
- G. Filter: The unit shall have a 1" filter rack with a reusable filter.
- H. Coil:
 - 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
 - 2. The coils shall be pressure tested at the factory.
 - 3. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil.
 - 4. Both refrigerant lines to the PVFY indoor units shall be insulated in accordance with the installation manual.
- I. Controls:
 - 1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
 - 2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8⁰ F deadband from set point.

2.13 BRANCH CIRCUIT (BC) CONTROLLERS

- A. Mitsubishi model CMB-P104NU-J1 branch circuit (BC) controller, as scheduled on the Drawings or approved equal. The BC controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.
- B. The BC controllers shall be specifically used with R410A, "City Multi R2-series" systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish.
- C. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

- D. BC Unit Cabinet: The casing shall be fabricated of galvanized steel. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves. The unit shall house two tube-in-tube heat exchangers.
- E. Refrigerant: R410A refrigerant shall be required.
- F. Refrigerant valves:
 - 1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 - 2. Each branch shall have multiple two-position valves to control refrigerant flow.
 - 3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 - 4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- G. Integral Drain Pan: An integral drain pan and drain shall be provided
- H. Electrical:
 - 1. The BC Controller shall be controlled by integral microprocessors
 - 2. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.14 DUCTWORK

- A. Sheet Metal Ductwork:
 - 1. Ducts and plenums shall be fabricated and installed in conformance with the latest editions of NFPA 90A; California Building Code; California Mechanical Code and the SMACNA HVAC Duct Construction Standards (Metal & Flexible). Ducts and plenums shall be constructed of hot-dipped galvanized steel, G90/Z275 coated, of lockforming grade conforming to ASTM A653 and A924 standards. Ducts to have mill phosphatized finish for surfaces exposed to view.
 - 2. Seals shall be airtight Class "B" seals at all transverse joints and longitudinal seams. Tables and figures hereinafter referenced are from the 2005 edition of the SMACNA HVAC Duct Construction Standards (Metal and Flexible).
 - 3. Rectangular duct construction shall conform to Table 2-3. All transverse joints shall be flanged per Table 2-32, with corner closures or "Duct Mate" flanged connections with corner closures per Figure 2-16 or 2-17. Elbows shall be standard radius (Type RE 1) or square throat with vanes (Type RE 2) per Figure 4-2, with double thickness turning vanes per Figures 4-3 and 4-4. Offsets and transitions shall be per Figure 4-7. Supply, return, and exhaust branch connections shall be per Figure 4-5 or 4-6. Splitters SHALL NOT be used.
 - 4. Round ducts shall be spiral, United McGill or equal. All transverse joints and longitudinal seams shall have Class "B" seals. All branches in round duct systems shall be made with factory fabricated reducing wye branches. Duct turns shall be made with standard, factory fabricated, three-piece elbows.
 - 5. Lined ducts shall be fabricated such that the net inside dimensions equals the duct sizes shown on the Drawings.
 - 6. Flexible ducts shall be acoustical type, Flexmaster "6M", Casco "Silent Flex – SF-18M", or approved equal. Flexible ducts shall be used only where shown on the Drawings, and maximum length of any given flexible duct shall not exceed 7 feet. Galvanized sheet metal elbows shall be used for turns greater than 45 degrees on flexible ducts 10 inches and larger. Connections to rectangular ducts shall be made with "spin-in" fittings with air scoops. The installation of flexible ducts shall conform to Figure 3-10, with the exceptions noted herein.
 - 7. Supports for horizontal ducts and plenums shall be fabricated per Figures 5-5 and 5-6 and Tables 5-1, 5-2 and 5-3. The maximum distance between hangers shall be 8 feet for

rectangular ducts and 12 feet for round ducts. Attachments to the structure shall be made with adequately sized lag bolts for strap hangers and adequately sized machine bolts and side beam brackets for rod hangers. Supports for vertical ducts shall be band iron strap or angle bracket type per Figures 5-8 and 5-9.

8. All roof-mounted ductwork shall be water tight and sloped to shed water. All transverse joints shall be T-25 flanged Ductmate "25", or approved equal.
9. Outside air intakes shall be type 316 stainless steel.

B. Fiberglass Ductwork:

1. Fiberglass ductwork is unacceptable and may not be used on this project.

C. Specialties:

1. Duct Mounted Access Doors
 - a. Including those for removing filters, duct access doors shall be fabricated as detailed in Figure 7-2, with sash locks, piano hinges, and gaskets. Round duct shall be fabricated as detailed in Figure 7-3.
 - b. Access doors shall be double wall, rectangular, insulated or uninsulated same as duct. Insulation fill and thickness shall be as indicated for pressure class.
 - c. Access doors shall have a vision panel and shall have an unobstructed full swing.
 - d. Fabricate doors airtight and suitable for duct pressure class.
2. Dampers:
 - a. Provide butterfly or multiple blade dampers, where indicated on the Drawings or as required for balancing air quantities, to values shown, without generating excessive noise. Provide Duro-Dyne "KS-385" or approved equal, locking quadrants on each manual damper. Locate dampers in furred ceilings near access panels, where possible.
 - b. Butterfly dampers shall be constructed per Figure 7-4, Figures A, B, and C.
 - c. Multi-blade dampers shall conform to Figure 7-5.
 - d. Motorized dampers - See Temperature Controls.
 - e. Backdraft damper: Ruskin CBD6 or approved equal, heavy duty dampers with 12 gauge galvanized steel structural brace at each corner. Blades shall be of extruded aluminum with extruded vinyl blade edge seals mechanically locked into blade edge. Corrosion resistant bearings, long life synthetic type. Linkage shall be tiebar connected to stainless steel pivot pins.
3. Remote Actuators:
 - a. Young Regulator Company, concealed ceiling damper regulator model 315 or approved equal. Remote Cable Control System Kit, model 270-275. All dampers in inaccessible ceilings shall have remote actuators. Paint
4. Air Extractors:
 - a. Duct mounted volume extractors made of galvanized steel with 1-inch blade spacing, Titus model "AG-45", or equal.
5. Flexible Duct Connections:
 - a. Duro-Dyne "Metal-Fab" constructed of Durolon, Ventfabrics "ventglas", or approved equal. Install at each point where a blower unit is connected to a duct. A minimum clearance of 3 inches between the duct and the source of vibration shall be maintained. Install per Figure 7-8.
6. Screens:
 - a. Install removable bird screens at all outside air intakes and exhaust air discharges. Screens shall be fabricated from ½ inch x 14-gauge mesh secured in full frames. Screens and frames shall be constructed of the same material as the duct, hood, or equipment to which attached.
7. Access Panels:
 - a. Milcor, Style M, prime coated steel, or approved equal. Minimum size shall be 10" x 10". Provide larger sizes where required. Locks shall be flush, screwdriver operated. Provide as required for concealed ducts at all fire dampers, electric duct heaters, and automatic dampers, except at suspended acoustical ceilings.

- 8. Joints:
 - a. Tape all joints airtight, using Carlisle Hardcast, Two Part II Sealing System with type “DT” pressure-less tape and “RTA 50” liquid sealant. Install per manufacturer’s directions.

2.15 INSULATION

A. General

- 1. All duct insulation materials including jackets, tapes, adhesives and coatings shall meet ASTM E84/UL 723 "25/50 Flame Spread/Smoke Development" requirements and NFPA 90A and 90B.

B. Exterior of Ductwork: (Flexible Duct Wrap)

- 1. Unless specified to be lined, all ductwork shall be externally insulated by wrapping with formaldehyde-free, flexible glass fiber blanket or inorganic glass mineral wool wrap, with factory applied FSK vapor barrier jacket. Thickness shall be 2 inches unless noted or required otherwise.
- 2. Duct wrap shall meet the requirements of ASTM C1290, ASTM C553, and ASTM C1136. Corrosiveness shall meet ASTM C665. Mold growth/fungi resistance shall meet ASTM C1338.
 - a. Johns Manville “Microlite FSK”, Knauf “Atmosphere Duct Wrap”, or Certainteed “SoftTouch” or “Wide Wrap”.

C. Interior of Ductwork: (Duct Liner)

- 1. All ducts exposed to the weather shall be internally insulated. All other ductwork within 10 feet of a fan (supply and return) shall be internally insulated. Duct liner shall be installed in supply and return ducts and plenums where noted on the Drawings. Exhaust ductwork need not be insulated.
- 2. Duct liner shall meet the requirements of ASTM C1071. Operating temperature shall meet ASTM C411. Microbial growth shall meet ASTM C1338, and ASTM G21 and G22.
 - a. Type I - Flexible Duct Liner: Johns Manville “Linacoustic RC”, Knauf “Atmosphere Duct Liner”, or Owens Corning “QuietR Rotary Duct Liner”. Thickness shall be 1 ½ inches, unless otherwise noted.
 - b. Type II - Plenum Liner Board: Johns Manville “Linacoustic R-300”, Owens Corning “QuietR Duct Liner Board”, or Knauf Insulation “Atmosphere Rigid Plenum Liner”. Thickness shall be 1 ½ inches, unless otherwise noted.

D. Refrigerant Piping:

- 1. Insulate all refrigerant suction lines, fittings, and valves with ¾" thick flexible elastomeric thermal insulation, Resolco Insul-Phen rigid closed cell phenolic foam, or equal, according to manufacturer’s suggested insulation thickness and installation procedures, UV protected.
- 2. Liquid, suction, and hot gas (where applicable) lines shall be insulated individually.
- 3. Oil equalization lines between multiple condensing units shall be insulated.
- 4. Pipe insulation thickness shall be as follows:

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			1 and less	1 to <1.5	1.5 to <4	4 to <8	8 and lgr
			INSULATION THICKNESS REQUIRED (in inches)				
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5

- E. All tanks, expansion tank, pumps, volutes, valves and strainers shall be completely insulated with ½" AP Armaflex glued and sealed vapor tight in place with Armstrong #520 adhesive.

2.16 ACCESS DOORS

- A. Where construction is not inherently accessible, provide adequately sized and conveniently located access doors at ceilings, walls, and furring for access to controls and for servicing valves, equipment, etc.
- B. Access doors shall be flush, prime coated steel except for tiled surfaces, screwdriver operated latch/locks, except for fire-rated. Minimum size shall be 12" x 12". Provide larger sizes where required.
 - 1. Fire Rated walls and ceilings: Milcor style UFR, Karp style KRP, or approved equal, U.L. Class B, 1½ hour rated, 20-gauge steel door; 16-gauge steel frame; insulated, self-closing, continuous piano hinge; keyed paddle latch, interior latch release.
 - 2. Drywall ceilings or walls: Milcor style DW, Karp style KDW or approved equal, drywall bead; 16-gauge steel frame & door or 16-gauge steel frame & 14-gauge steel door; concealed spring hinge
 - 3. Masonry walls: Milcor style M, Karp style DSC-214M, or approved equal, 16-gauge steel frame & door or 16-gauge steel frame & 14-gauge steel door; spring loaded hinge
 - 4. Tiled walls and ceilings: Milcor style MS, Karp style DSC-214M(S), or approved equal, 16-gauge stainless steel frame & door or 16-gauge stainless steel frame & 14-gauge stainless steel door; satin finish; spring loaded hinge
 - 5. Plastered walls and ceilings: Milcor style K, Karp style DSC-214PL, or approved equal, 16-gauge steel frame; 14-gauge steel door; casing bead; concealed spring hinge or continuous piano hinge
- C. Doors shall be delivered to the General Contractor for installation.

2.17 FILTERS

- A. Unless indicated otherwise on the equipment schedule, air filters shall be 2-inch completely disposable type with fiberglass media, AAF/Flanders "Pre-Pleat M13", Camfil "AP-Thirteen", or approved equal, UL Class 2 listed. Permanent washable types are not acceptable. Change filters at job completion and furnish one complete filter change boxed at the jobsite for owner.
- B. Each filter shall consist of synthetic only media, with corrosion-resistant expanded metal backing and moisture resistant enclosing frame. The filter shall be 2" nominal depth. The grid shall be 100% bonded to the media on the air exiting side to eliminate media vibration and pull-away.
- C. The grid shall be formed to provide a uniform V-wedge shaped pleat with the open area on the air exiting side for maximum utilization of the media and low airflow resistance. The filter shall be classified for flammability by Underwriters Laboratories, Standard 900 as Class 2.
- D. The filter shall have a Minimum Efficiency Reporting Value (MERV) of 13 by ASHRAE Standard 52.2.
- E. Filters to be provided during construction, upstream of air handling units, at return grilles, or any other return duct openings shall be Camfil "30/30" pleated panel filters, AAF/Flanders, or approved equal. MERV 8
- F. Systems shall not be operated without properly installed filters, including temporary filters for use during construction. If the final pressure drop of the temporary filters is reached during the construction or test and balance, replace them with the spare set. If not used, the spare set is to be delivered to the Owner at the time of acceptance.

PART 3 - - EXECUTION

3.1 PROJECT CONDITIONS

- A. Prior to commencing the work of this Section, this Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section and that the completed work will be in complete accordance with the original design. In the event of discrepancy immediately notify the Architect and proceed as he directs.

3.2 VERIFICATION OF EXISTING CONDITIONS

- A. The data given herein and on the Drawings are as exact as could be reasonably secured, but absolute accuracy is not guaranteed. The location of existing mechanical equipment, ductwork air outlets, piping, controls, valves, etc. has been based on the best available information obtainable at the site and through record drawings. Contractor shall verify exact locations, sizes, and extent of existing systems prior to start of demolition work.
- B. Information shown relative to existing services is based upon available records and data during preparation of the Drawings but shall be verified. Make reasonable deviations found necessary to conform with actual locations and conditions, without extra charge.
- C. Prior to commencing the work of this Section, the Contractor shall inspect the installed work of other trades and verify that their work is sufficiently complete to permit the start of work under this Section, and that the completed work will be in complete accordance with the original design. In the event of discrepancy, immediately notify the Architect and proceed as directed.
- D. All mechanical equipment, piping, valves, controls, etc. that are rendered useless by this work shall be demolished and removed from the site. Remove piping, controls, fixtures, and equipment that is not to remain in service as shown on the Drawings or as required. This includes the removal of associated appurtenances and supports.
- E. Patch, cap, or repair existing works affected by this demolition in concealed spaces within 6" of a live main or branch. Patch all walls, ceilings, roof and other surfaces to match existing conditions.
- F. The contractor shall retain specific equipment as directed by owner and deliver to owner specified location. Deliver removed material to the Owner as directed by the Architect. Dispose of all other removed material offsite.

3.3 POLLUTANT CONTROL

- A. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheetmetal or other methods acceptable to the enforcing agency to reduce the amount of dust or debris which may collect in system.
- B. During construction, protect all filters upstream of air handling units with blankets of 2" fiberglass filter media or 2" disposable panel filters. UL Class 2 listed. Remove after balancing, and prior to acceptance.

3.4 INSTALLATION, GENERAL

- A. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not

install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

- B. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- C. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect of any discrepancy.

3.5 AIR CONDITIONING EQUIPMENT

- A. All units shall be set with curbs plumb, level, and securely attached through framed opening with bolts and/or lag screws as noted on the Drawings. Connections to ductwork shall be secured, filter racks shall be aligned, enclosures and ductwork connections shall be fully waterproofed, and all utility and control connections shall be complete.

3.6 INSULATION INSTALLATION

- A. Exterior Ductwork:
 - 1. Duct wrap shall be cut in a manner to meet the manufacturers' stretch-out guideline to provide a 2" staple lap and have minimum compression at the corners. All joints shall be lapped 2" and stapled with outward clinching staples 2" on center. The insulation shall be mechanically fastened to the underside of all ducts 24" wide or more using cup-head pins, weld pins, or stick pins with speed clips 18" on center. Insulation shall not be compressed to comply with required installed R-value. All joints and penetrations of the vapor barrier jacket shall be sealed with a minimum 3" wide matching pressure sensitive tape. Pressure-sensitive tape shall be firmly rubbed in place immediately after application using a "squeegee" type tool.
 - 2. When a vapor seal is required, two coats of vapor retarder mastic reinforced with one layer of 4" wide, open weave glass fabric may be used in lieu of pressure-sensitive tape. Mastic shall be brushed onto joint and glass fabric imbedded in it. A second coat of mastic shall be brushed over the glass fabric until the fabric is filled. Mastics shall be applied in accordance with application instructions on the container.
- B. Interior Duct Liner
 - 1. Apply to the inside face of ducts, coated side facing air stream. Fasten using fire retardant adhesive and secure with mechanical fasteners at 12" maximum o.c., both directions, for velocities up to 2,500 fpm. Velocities over 2,500 fpm shall have fastener spacing of 6" o.c.
 - 2. Exposed edges must be factory or field coated with adhesive. Metal nosing shall be installed in all liner leading edges facing the airstream at fan discharge, at access doors, and at any interval of lined duct preceded by unlined duct.
 - 3. Insulation with torn or broken coatings shall be removed and replaced. Loose corners, edges, and butt joints will not be accepted.
 - 4. Maximum velocity: 5,000 ft/min.
- C. Refrigerant Piping:
 - 1. The insulation shall be installed in accordance with the manufacturer's instructions. All joints and seams shall be sealed with waterproof vapor retarder adhesive. All pipes exposed to the weather shall be coated to protect the insulation from ultra-violet radiation in accordance with the manufacturer's published instructions.

3.7 EARTHWORK

- A. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Section in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
- B. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
- C. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

3.8 DUCTWORK

- A. All ductwork shall be installed within spaces provided where possible. Ducts shall be installed true to line and grade, fully secured to structural framing with specified hangers and supports, insulated, and vibration isolated.
- B. Each section of supply air ductwork shall be cleaned, dust and oil free, at the shop using a degreasing agent and detergent and sealed airtight at both ends with visqueen and tape. Supply ducts shall be additionally cleaned with a disinfecting solution. Ends of all supply and internally insulated exhaust ducts shall be kept sealed until the time they are joined. When duct sections are joined, wipe down all interior surfaces with a clean tack cloth. If tack cloth shows any dust, then re-clean duct as described above. The intent is that no foreign matter be allowed to enter the ductwork at any time after factory cleaning and during construction.
- C. Unlined exhaust ducts shall be vacuum cleaned when installed, but shall otherwise be exempt from shop cleaning and sealing.

3.9 PIPE INSTALLATION

- A. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
- B. Include provisions for servicing and removal of equipment without dismantling piping.

3.10 REFRIGERANT PIPING INSTALLATION

- A. Piping installation shall comply with all federal, state, and local regulations and industry guidelines. In addition, the following practices shall be followed.
 - 1. All piping shall be stored with ends sealed to prevent entry of moisture and debris.
 - 2. A pipe cutter specific to the piping material applied shall be used.
 - 3. All factory and field cut tube ends shall be de-burred and cleaned.
 - 4. Flared fittings shall be formed using tools recommended by the equipment manufacturer.
 - 5. Flare nuts shall be tightened with torque wrench furnished by the equipment manufacturer.
 - 6. Piping shall be continuously purged with dry nitrogen while soldering. Care shall be taken when soldering near valves or other equipment that may be damaged by extreme heat.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

- C. Install refrigerant piping according to ASHRAE 15.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- I. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection
- J. Install refrigerant piping in protective conduit where installed belowground. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- K. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Use double-suction riser for maximum compressor efficiencies if load variation is expected.
 - 4. Install traps and double risers to entrain oil in vertical runs.
 - 5. Liquid lines may be installed level.
- L. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- M. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- N. All refrigerant piping and valves shall be identified.

3.11 FILTERS

- A. During construction, protect all filters upstream of air handling units with blankets of 2" fiberglass filter media or 2" disposable panel filters. UL Class 2 listed.
- B. Systems shall not be operated without properly installed filters. Filters used during construction shall be removed and replaced with new filters after construction is completed and the systems are ready for final acceptance by the owner.

3.12 TESTS, INSPECTIONS

- A. Contractor shall not allow or cause any work of this Section to be covered or enclosed until it has been inspected, tested, and approved by the Architect and the authorities having jurisdiction over the Work. Should any of this work be enclosed or covered up before such inspection, testing, and approval, this Contractor shall uncover the work, have the necessary inspections, tests, and approvals made and, at no expense to the Owner, make all repairs necessary to restore both his work and that of other contractors which may have been damaged to be in conformity with the Contract Documents.
- B. Furnish all necessary labor, materials, and equipment for conducting tests, and pay all expenses in connection therewith. Should leaks develop while testing, repairs shall be made, and tests shall be repeated until a satisfactory test is obtained.
- C. In any test, proper safety procedures and equipment shall be used, including personal protective equipment such as protective eyewear and clothing. Installers shall always consider local conditions, codes and regulations, manufacturer's installation instructions, and Architects'/Engineers' specifications in any installation.
- D. Make all necessary control adjustments and balancing of air and water flows. Operate the entire system for a period of time not less than 3 working days for the purpose of proving satisfactory performance. During this period, instruct such persons as the Owner and/or Architect may designate in the proper operation of the systems. Should further adjustment prove necessary, operating tests shall be repeated until a satisfactory test result is obtained.

3.13 CONTRACTOR REQUIREMENTS FOR TEST & BALANCE

- A. Provide T&B agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats.
- B. Provide additional valves, dampers, sheaves and belts as required by T & B agency.
- C. Flag all manual volume dampers with fluorescent or other high-visibility tape.
- D. Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by T & B agency.
- E. Replace or repair insulation as required by T & B agency.
- F. Have the HVAC systems at complete operational readiness for T & B to begin. As a minimum, verify the following:
 - 1. Airside:
 - a. All ductwork is complete with all terminals installed.
 - b. All volume, smoke and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. All fans are operating free of vibration and rotating in correct direction.
 - e. VFD start-up is complete and all safeties are verified.
 - f. System readiness checklists are completed and returned to T&B agency.
 - A. Promptly correct deficiencies identified during T&B.

3.14 REFRIGERANT PIPING TESTING

- A. Prior to charging with refrigerant, piping shall be tested for leaks under 550 psi pressure using a mixture of 95% nitrogen and 5% hydrogen gas. (WARNING! OXYGEN OR ACETYLENE

SHALL NOT BE USED IN PLACE OF DRY NITROGEN. A VIOLENT EXPLOSION MAY RESULT!).

- B. All joints shall be tested for leaks using an electronic hydrogen leak detector. Pressure and leak tests on refrigeration piping and equipment shall be done in accordance with local code requirements and ANSI B9.1.
- C. Piping shall be continuously purged with dry nitrogen while brazing. Care shall be taken when soldering near valves or other equipment that may be damaged by extreme heat.
- D. Be sure that all controls, relief valves or rupture discs that could be damaged by test pressure are removed before beginning pressure test.
- E. Precautions shall be taken to keep moisture out of the system, and a drier shall be used.
- F. After successful completion of pressure tests, the entire system shall be purged with dry nitrogen and then evacuated with a standard vacuum pump to remove all moisture and non-condensibles. Three evacuations shall be required, and shall be down to 500 microns absolute pressure. Break the first two vacuums with dry nitrogen. Charge with refrigerant after third evacuation.
- G. The Contractor shall notify the Owner's representative 48 hours prior to the time and date of the evacuation.
- H. The refrigerant charge shall be calculated and weighed into the system.
- I. Service technicians shall be certified in the use of CFC and HCFC refrigerant recovery and recycling equipment and shall use UL listed and labeled recovery equipment when discharging refrigerant.

3.15 CONTRACTOR RESPONSIBILITIES

- A. Provide T&B agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats. Project Schedule and Mechanical Contractor's Shop Drawings and Temperature Control Drawings shall be provided as issued or received.
- B. Controls contractor shall provide required BAS hardware, software, personnel and assistance to T&B agency as required to balance the systems. Controls contractor shall also provide trending report to demonstrate that systems are complete.
- C. Coordinate meetings and assistance from suppliers and contractors as required by T&B agency.
- D. Provide additional valves, dampers, sheaves and belts to properly test and balance, which shall be installed by the Mechanical Contractor as directed by T&B agency, at no additional cost to owner.
- E. Mechanical Contractor shall install test holes where indicated by the T&B Agency. Test holes shall be complete with removable and replaceable plugs
- F. Flag all manual volume dampers with fluorescent or other high-visibility tape.
- G. Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by T&B agency.
- H. Replace or repair insulation as required by T&B agency.

- I. Have the HVAC systems at complete operational readiness for T&B to begin. As a minimum verify the following:
 - 1. Airside:
 - a. All ductwork is complete with all terminals installed.
 - b. All volume, smoke and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. All fans are operating, free of vibration, and rotating in correct direction.
 - e. VFD start-up is complete and all safeties are verified.
 - f. System readiness checklists are completed and returned to T&B agency.
- J. Promptly correct deficiencies identified during T&B.
- K. Maintain a construction schedule that allows the T&B agency to complete work prior to occupancy.
- L. Before testing or balancing is started, the Mechanical Contractor shall adjust belts and sheaves; align all parts; oil and grease bearings in accordance with manufacturer's instructions; clean exterior surfaces of coil tubes and fins; flush interior of coil tubes, pull until clean; and check mixing damper operation to insure free operation and activation by the correct thermostat
- M. The Mechanical Contractor shall be responsible for certifying in writing that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but the Mechanical Contractor's certification that the prime movers are installed in good working order, and that full load performance has been preliminary tested under the certification of the Mechanical Contractor. Before any testing and balancing is started, a complete report shall be sent to the T&B Agency by the Mechanical Contractor.
- N. The Mechanical Contractor shall be responsible for making all modifications to rectify discrepancies reported by the T&B Contractor as indicating non-compliance with the Contract Documents. By completing the work on time, the Mechanical Contractor shall provide sufficient time before the completion date so that balancing can be accomplished.

3.16 CLEANUP

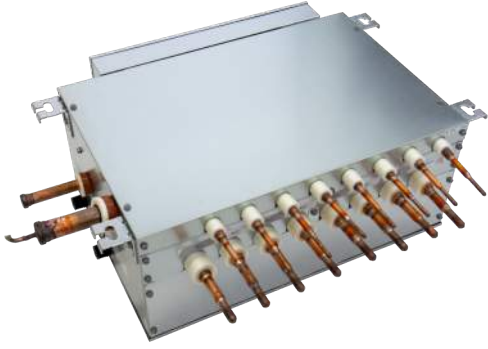
- A. Upon completion of the work of this Section, remove all material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION

Job Name:

System Reference:

Date:



ACCESSORIES

- Branch Joint (Downstream capacity ≤72,000 Btu/h)..... CMY-Y102SS-G2*
- Branch Joint (Downstream capacity 73,000-96,000 Btu/h)..... CMY-Y102LS-G2*
- Condensate Pump (Blue Diamond)..... X87-721
- Condensate Pump (Sauermann)..... SI3100-230
- Ball Valve (3/8" SAE Brazed)..... BV38BBSI
- Ball Valve (5/8" SAE Brazed)..... BV58BBSI
- Reducer (Between ODU and BC)..... CMY-R301S-G

*See Data Book or Install Manual for more details

SPECIFICATIONS

Indoor Unit Capacity Connectable to 1 Branch	Btu/h	54,000
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Number Of Branches	4
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Electrical Requirements		
Electrical Power Requirements	208 / 230V, 1 phase, 60Hz	
Minimum Circuit Ampacity (MCA)	A	0.38 / 0.44

Power Input (208 / 230V)		
Cooling	kW	0.061 / 0.078
Heating		0.030 / 0.039

Current Input (208 / 230V)		
Cooling	A	0.30 / 0.35
Heating		0.15 / 0.18

External Dimensions	In. (mm)	9-7/8 x 23-1/2 x 15-11/16 (250 x 596 x 398)
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Net Weight	Lbs. (kg)	58 (26)
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External finish	Galvanized steel plate (Lower part drain pan: Pre-coated galvanized sheets + powder coating)
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Connectable Outdoor / Heat Source Unit Capacity	72,000 to 120,000
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Refrigerant Piping Diameter to Indoor Unit (Brazed)			
		Liquid	Gas
Less than 18,000 Btu/h	In. (mm)	1/4 (6.35)	1/2 (12.7)
	In. (mm)	3/8 (9.52)	5/8 (15.88)
Greater than 18,000 Btu/h	In. (mm)	3/8 (9.52)	3/4 (19.05)
	In. (mm)	3/8 (9.52)	7/8 (22.2)

Refrigerant Piping Diameter to Outdoor Unit (Brazed)			
		High Pressure	Low Pressure
P72	In. (mm)	5/8 (15.88)	3/4 (19.05)
P96	In. (mm)	3/4 (19.05)	7/8 (22.2)
P120	In. (mm)	3/4 (19.05)	7/8 (22.2) or 1-1/8 (28.58)

Field drain pipe size	In. (mm)	3/4 NPT
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Refrigerant	R410A
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Sound power level (measured in anechoic room)		
Rated operation	dB(A)	59
Defrost		71

Sound pressure level (measured in anechoic room)		
Rated operation	dB(A)	40
Defrost		53

NOTES:

1. Installation/foundation work, electrical connection work, insulation work, power source switch, and other items shall be referred to the Installation Manual.
2. The equipment is for R410A refrigerant.
3. Install this product in a location where noise (refrigerant noise) emitted by the unit will not disturb the neighbors. (For use in quiet environments with low background noise, position the BC CONTROLLER at least 5m away from any indoor units.)
4. Sound pressure/power level differs depending on the connected outdoor/heat source unit capacity or operation condition. The sound pressure/power level at the rated operation is the value of the cooling mode.
5. The sound pressure/power level values were obtained in an anechoic room. Actual sound pressure level is usually greater than that measured in anechoic room due to ambient noise and deflection sound.
6. The sound pressure level values were obtained at the location below 1.5m from the unit.
7. The solenoid valve switching sound is 56 dB (sound pressure level) regardless of the unit model.
8. Refrigerant piping diameter for connection of plural indoor units with 1 branch shall be referred to the Installation Manual.
9. This unit is not designed for outside installations.
10. When brazing the pipes, be sure to braze, after covering a wet cloth to the insulation pipes of the units in order to prevent it from burning and shrinking by heat.
11. Indoor unit capacity connectable to 1 branch is changed depending on the indoor unit type and connection method. Please refer to the Installation Manual for more information.
12. For the refrigerant pipe size, refer to Installation Manual of outdoor units/heat source units.

Model: CMB-P104NU-J1 - DIMENSIONS

CMB-P104, 106, 108NU-J1

Unit: mm(in)

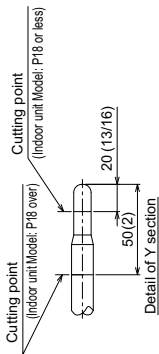
- <Accessories>
 • Square washer (with cushion)4-pcs.
 • Square washer4-pcs.

- Note 1. Suspension bolt (ø10) and nut (M10) prepare in the field.
 2. Take notice of service space as shown.
 (Please give attention not to occupy service space by letting ducts and pipes through.)
 3. Install this product in a location where noise (refrigerant noise) emitted by the unit will not disturb the neighbors.
 (For use in quiet environments with low background noise position the BC CONTROLLER at least 5m away from any indoor units.)
 4. Refer to the Installation Manual for refrigerant piping diameter size when connecting plural indoor units with 1 branch.
 5. Refer to the Table-1 for connection pipe of outdoor unit diameter size.
 6. Refer to the Installation Manual for insulation of connection pipe and drain piping.
 7. Do not place the BC controller directly on the floor.

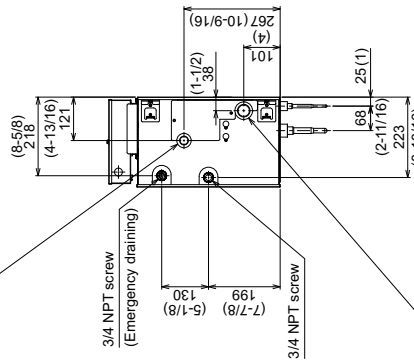
Table-1. To outdoor/heat source unit (Note.5)

Connectable unit capacity	High press. Pipe	Low press. Pipe
P72	ø15.88 (5/8)	ø19.05 (3/4)
P96	ø19.05 (3/4)	ø22.2 (7/8)
P120	ø19.05 (3/4)	ø28.58 (1-1/8)

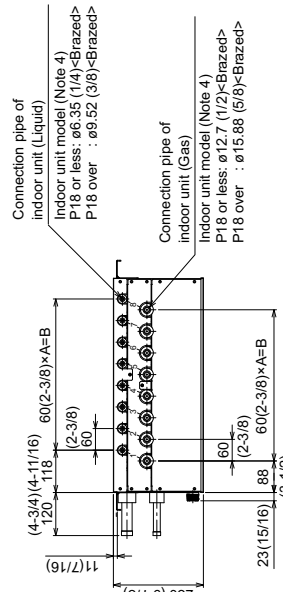
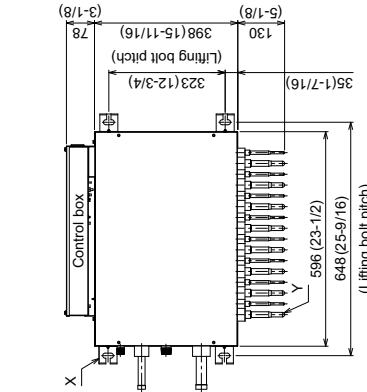
*For the refrigerant pipe size, refer to Installation Manual of outdoor units/heat source units.



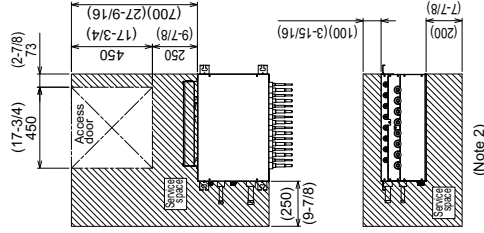
Detail of X section
 Connection pipe of outdoor unit (High pressure)
 ø19.05 (3/4) (Note 5)



Connection pipe of outdoor unit (Low pressure)
 ø28.58(1-3/16) (Note 5)



	A	B
CMB-P104NU-J1	3	180 (7-1/8)
CMB-P106NU-J1	5	300 (11-13/16)
CMB-P108NU-J1	7	420 (16-9/16)



(Note 2)

BC controller



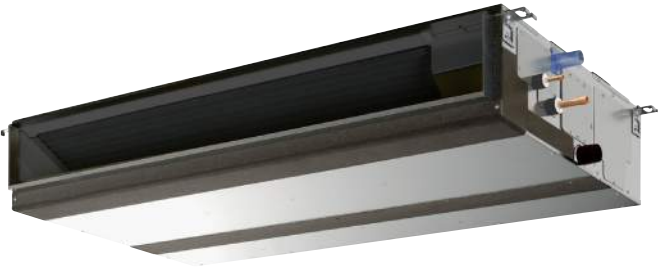
1340 Satellite Boulevard, Suwanee, GA 30024
 Toll Free: 800-433-4822 www.mehvac.com



Job Name:

Schedule Reference:

Date:



GENERAL FEATURES

- Dual set point functionality
- Multiple fan speed settings
- Auto fan mode
- 9-7/8" (250mm) high for low ceiling heights
- Built-in condensate lift; lifts to 27-9/16" (700 mm)
- Ducted fan coil supporting multiple configurations for flexible installation

OPTIONS

- External Heater Adapter.....CN24RELAY-KIT-CM3
- Filter Box (Includes 2" MERV 13 filter).....FBM2-2

SPECIFICATIONS

Capacity*

Cooling.....15,000 Btu/h
 Heating.....17,000 Btu/h

Power

Power Source.....208 / 230V, 1-phase, 60Hz

Power Consumption

Cooling.....0.09 kW
 Heating.....0.07 kW

Current

Cooling.....0.67 A
 Heating.....0.56 A
 Minimum Circuit Ampacity (MCA).....1.45 A
 Maximum Overcurrent Protection (MOCP) Fuse.....15 A

External Finish.....Galvanized-steel Sheet

External Dimensions

Inches.....9-7/8 H x 35-7/16 W x 28-7/8 D
 mm.....250 H x 900 W x 732 D

Net Weight.....58 lbs. / 26 kg

Coil Type.....Cross Fin
 (Aluminum Plate Fin and Copper Tube)

Fan

Type x Quantity.....Sirocco Fan x 1
 Airflow Rate (Low-Mid-High)..... 353 - 424 - 494 CFM
 External Static Pressure.....0.14 - 0.20 - 0.28 - 0.40 - 0.60"WG
 Motor Type.....DC Motor

Air Filter.....Polypropylene Honeycomb

Refrigerant Piping Dimensions

Liquid (High Pressure).....1/4" / 6.35 mm (Brazed)
 Gas (Low Pressure).....1/2" / 12.7 mm (Brazed)

Drainpipe Dimension.....O.D. 1-1/4" / 32 mm

Sound Pressure Levels

Low-Mid-High.....28 - 30 - 34 dB(A)

* Cooling / Heating capacity indicated at the maximum value at operation under the following conditions:
 Cooling | Indoor: 80° F (27° C) DB / 67° F (19° C) WB,
 Cooling | Indoor: Outdoor 95° F (35° C) DB
 Heating | Indoor: 70° F (21° C) DB,
 Heating | Outdoor 47° F (8° C) DB / 43° F (6° C) WB

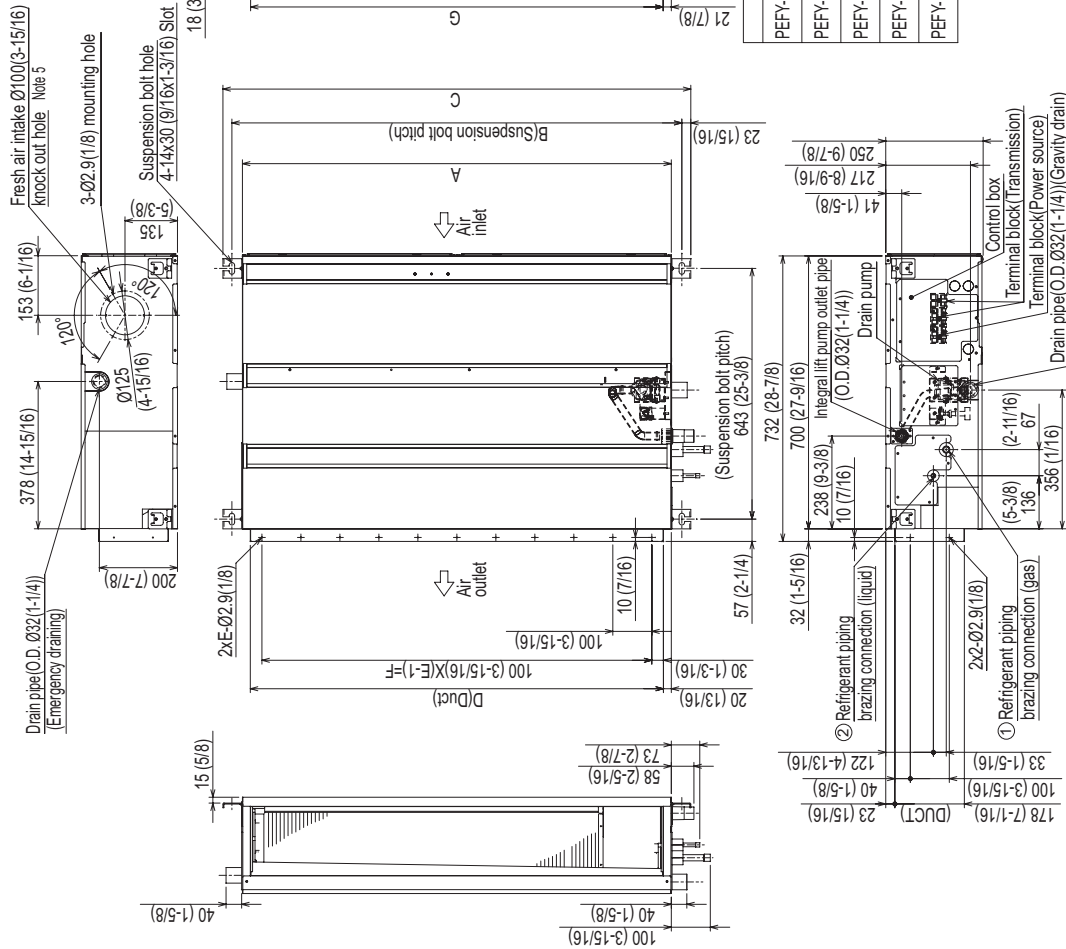
Notes:



Model: PEFY-P15NMAU-E3 – DIMENSIONS

Unit: mm (in)

- Note
1. Use an M10 screw for the suspension bolt (field supply).
 2. Keep the service space for maintenance at the bottom.
 3. This drawing is for PEFY-P24-27-30-36-48-54NMAU-E3 models, which have 2 fans. PEFY-P06-08-12-15-18NMAU-E3 models have 1 fan.
 4. If the inlet duct is used, remove the air filter (supplied with the unit), then install the filter (field supply) at the suction side.
 5. Heat air to 0°C (32°F) or higher when taking fresh air with a fresh air intake.



Model	① Gas pipe	② Liquid pipe
PEFY-P06,08,12NMAU-E3	Ø12.7 (1/2)	Ø6.35 (1/4)
PEFY-P15,P18NMAU-E3		
PEFY-P24,27,30NMAU-E3	Ø15.88 (5/8)	Ø9.52 (3/8)
PEFY-P36,48NMAU-E3		
PEFY-P54NMAU-E3		

Model	A	B	C	D	E	F	G
PEFY-P06,08,12NMAU-E3	700 (27-9/16)	754 (29-11/16)	800 (31-1/2)	660 (26)	7	600 (23-5/8)	658 (25-15/16)
PEFY-P15,P18NMAU-E3	900 (35-7/16)	954 (37-9/16)	1000 (39-3/8)	860 (33-7/8)	9	800 (31-1/2)	858 (33-13/16)
PEFY-P24,27,30NMAU-E3	1100 (43-5/16)	1154 (45-7/16)	1200 (47-1/4)	1060 (41-3/4)	11	1000 (39-3/8)	1058 (41-11/16)
PEFY-P36,48NMAU-E3	1400 (55-1/8)	1454 (57-1/4)	1500 (59-1/16)	1360 (53-9/16)	14	1300 (51-1/8)	1358 (53-11/2)
PEFY-P54NMAU-E3	1600 (63)	1654 (65-1/8)	1700 (66-15/16)	1560 (61-7/16)	16	1500 (59-1/16)	1558 (61-3/8)



Intertek

FORM# PEFY-P15NMAU-E3 - 201310A

Specifications are subject to change without notice.
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Job Name:

System Reference:

Date:

Indoor Unit:
PKA-A12HA7

Outdoor Unit:
 PUY-A12NKA7
 PUY-A12NKA7-BS



INDOOR UNIT FEATURES

- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES

- Variable speed INVERTER-driven compressor
- Power receiver pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- Low ambient cooling down to -40°F providing 100% capacity (only for PUY models with wind baffles installed)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restarts in cooling mode (15 seconds for 12/18/36/42; 50 seconds for 24/30)
- Superior energy and operational efficiency

SPECIFICATIONS: PKA-A12HA7 & PUY-A12NKA7(-BS)

Model Number	Indoor Unit		PKA-A12HA7	
	Outdoor Unit		PUY-A12NKA7	
			PUY-A12NKA7-BS	
Cooling ¹	Maximum Capacity	Btu/h	12,000	
	Rated Capacity	Btu/h	12,000	
	Minimum Capacity	Btu/h	5,800	
	Maximum Power Input	W	1,000	
	Rated Power Input	W	1,000	
	Moisture Removal	Pints/h	2.0	
	Sensible Heat Factor		0.81	
	Power Factor	%	94.5	
Efficiency	SEER		20.8	
	EER ¹		12.0	
Electrical	Voltage, Phase, Frequency		208 / 230V, 1-phase, 60 Hz	
	Guaranteed Voltage Range	V AC	198 – 253	
	Voltage: Indoor - Outdoor, S1-S2	V AC	208 / 230	
	Voltage: Indoor - Outdoor, S2-S3	V DC	24	
	Voltage: Indoor - Remote controller	V DC	12	
	Recommended Fuse/Breaker Size	A	15	
	Recommended Wire Size (Indoor - Outdoor)	AWG	14	
Indoor Unit	MCA	A	1	
	Fan Motor Full Load Amperage	A	0.33	
	Fan Motor Output	W	30	
	Airflow Rate, Dry	CFM	320-370-425	
	Airflow Rate, Wet	CFM	290-335-380	
	External Static Pressure	in.WG	n/a	
	Sound Pressure Level	dB(A)	36-40-43	
	Drain Pipe Size	In. (mm)	5/8 (16)	
	Condensate Lift Mechanism, Max. Distance	In. (mm)	n/a	
	Heat Exchanger Type		Plate fin coil	
	External Finish Color		White Munsell 1.0Y 9.2/0.2	
	Unit Dimensions	W: In. (mm)		35-3/8 (898)
		D: In. (mm)		9-13/16 (249)
		H: In. (mm)		11-5/8 (295)
	Package Dimensions	W: In.		39-6/16
		D: In.		15-12/16
H: In.			13-6/16	
Unit Weight	Lbs. (kg)		29 (13)	
Package Weight	Lbs.		33	
Indoor Unit Operating Temperature range	Cooling Intake Air Temp (Maximum / Minimum)	°F	90 DB, 73 WB / 66 DB, 59 WB	

SPECIFICATIONS: PKA-A12HA7 & PUY-A12NKA7(-BS)

Model Number	Indoor Unit		PKA-A12HA7	
	Outdoor Unit		PUY-A12NKA7	
			PUY-A12NKA7-BS	
Outdoor Unit	MCA	A	11	
	MOCP	A	28	
	Fan Motor Full Load Amperage	A	0.50	
	Fan Motor Output	W	46	
	Airflow Rate	CFM	1,590	
	Refrigerant Control	Electronic Expansion Valve		
	Heat Exchanger Type	Cross fin		
	Sound Pressure Level, Cooling ¹	dB(A)	44	
	Compressor Type	INVERTER-driven twin rotary		
	Compressor Model	SNB092FNCM		
	Compressor Rated Load Amps	A	7	
	Compressor Locked Rotor Amps	A	12	
	Compressor Oil Type // Charge	oz.	FV50S // 12	
	External Finish Color	Ivory Munsell 3Y 7.8/1.1		
	Base Pan Heater	n/a		
	Unit Dimensions	W: In. (mm)	31-13/16 + 7/16 (809+62)	
		D: In. (mm)	11-3/16 (300)	
		H: In. (mm)	24-13/16 (630)	
	Package Dimensions	W: In.	37-1/16	
		D: In.	16-3/16	
H: In.		27-7/16		
Unit Weight	Lbs. (kg)	92 (41)		
Package Weight	Lbs. (kg)	104 (47)		
Outdoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	115 DB / -40* DB	
Refrigerant	Type	R410A		
	Charge	Lbs, oz	4 lbs, 7 oz	
Piping	Gas Pipe Size O.D. (Flared)	In.(mm)	1/2 (12.7)	
	Liquid Pipe Size O.D. (Flared)	In.(mm)	1/4 (6.35)	
	Maximum Piping Length	Ft. (m)	165 (50)	
	Maximum Height Difference	Ft. (m)	100 (30)	
	Maximum Number of Bends	15		

SPECIFICATIONS: PKA-A12HA7 & PUY-A12NKA7(-BS)

Notes

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	¹ Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
*Wind baffles required to operate below 23F DB in cooling mode. For PUY models, wind baffles can be utilized to extend the cooling operation range to -40F. Please refer to the wind baffle submittals to determine which baffles are required to meet the desired operation range. **System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.			
SEACOAST PROTECTION <ul style="list-style-type: none">• External Outer Panel: Phosphate coating + Acrylic-Enamel coating• Fan Motor Support: Epoxy resin coating (at edge face)• Separator Assembly; Valve Bed: Epoxy resin coating (at edge face)• "Blue Fin" treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.			

ACCESSORIES: PKA-A12HA7

Signal Receiver	□ PAR-SA9CA-E
Wireless Remote Controller	□ PAR-FL32MA-E
Wireless Remote Receiver	□ PAR-FA32MA-E
Backlit, Wall-mounted, Wireless Controller	□ MHK1
Portable Central Controller	□ MCCH1
Wired MA Controller	□ PAR-33MAA
Simple MA Controller	□ PAC-YT53CRAU
Touch MA Controller	□ PAR-CT01MAU-SB
Wired Remote Sensor	□ PAC-SE41TS-E
Lockdown Bracket for Wireless, Hand-held, Remote Controller	□ RCMKP1CB
Wireless Temperature and Humidity Sensor	□ PAC-USWHS003-TH-1
Outside Air Sensor for MHK1	□ MOS1
Flush Mount Remote Temperature Sensor	□ PAC-USSEN001-FM-1
Wireless Interface	□ PAC-USWHS002-WF-1
Thermostat Interface	□ PAC-US444CN-1
kumo station®	□ PAC-WHS01HC-E
USNAP Interface	□ PAC-WHS01UP-E
IT Extender	□ PAC-WHS01IE-E
BACnet® and MODBUS® Interface	□ PAC-UKPRC001-CN-1
Connector for CN32 (remote on/off)	□ PAC-SE55RA-E
External Drain Pump	□ PAC-KE07DM-E
External Drain Pump	□ PAC-SH75DM-E
Blue Diamond Sensor Extension Cable—15 Ft.	□ C13-103
Mini Condensate Pump—230V application	□ SI30-230
MegaBlue Advanced Blue Diamond Condensate Pump w/ Reservoir & Sensor	□ X87-835 - 110 to 250V
MaxiBlue Advanced Blue Diamond Mini Condensate Pump w/ Reservoir & Sensor (208/230V) up to 48,000 Btu/h [recommended]	□ X87-721 - 208/230V
MicroBlue Blue Diamond Mini Condensate Pump (110/208/230V) up to 18,000 Btu/h	□ X85-003
Fascia Kit for MicroBlue Pump – mounts the MicroBlue and sensor directly beneath the indoor unit	□ T18-016
Drain Pan Level Sensor (Control for indoor unit shut off to prevent drain pan overflow)	□ DPLS2
3 Pole Disconnect Switch (30A/600VUL) [fits 2"X4" utility] - Black	□ TAZ-MS303
3 Pole Disconnect Switch (30A/600VUL) [fits 2"X4" utility] - White	□ TAZ-MS303W

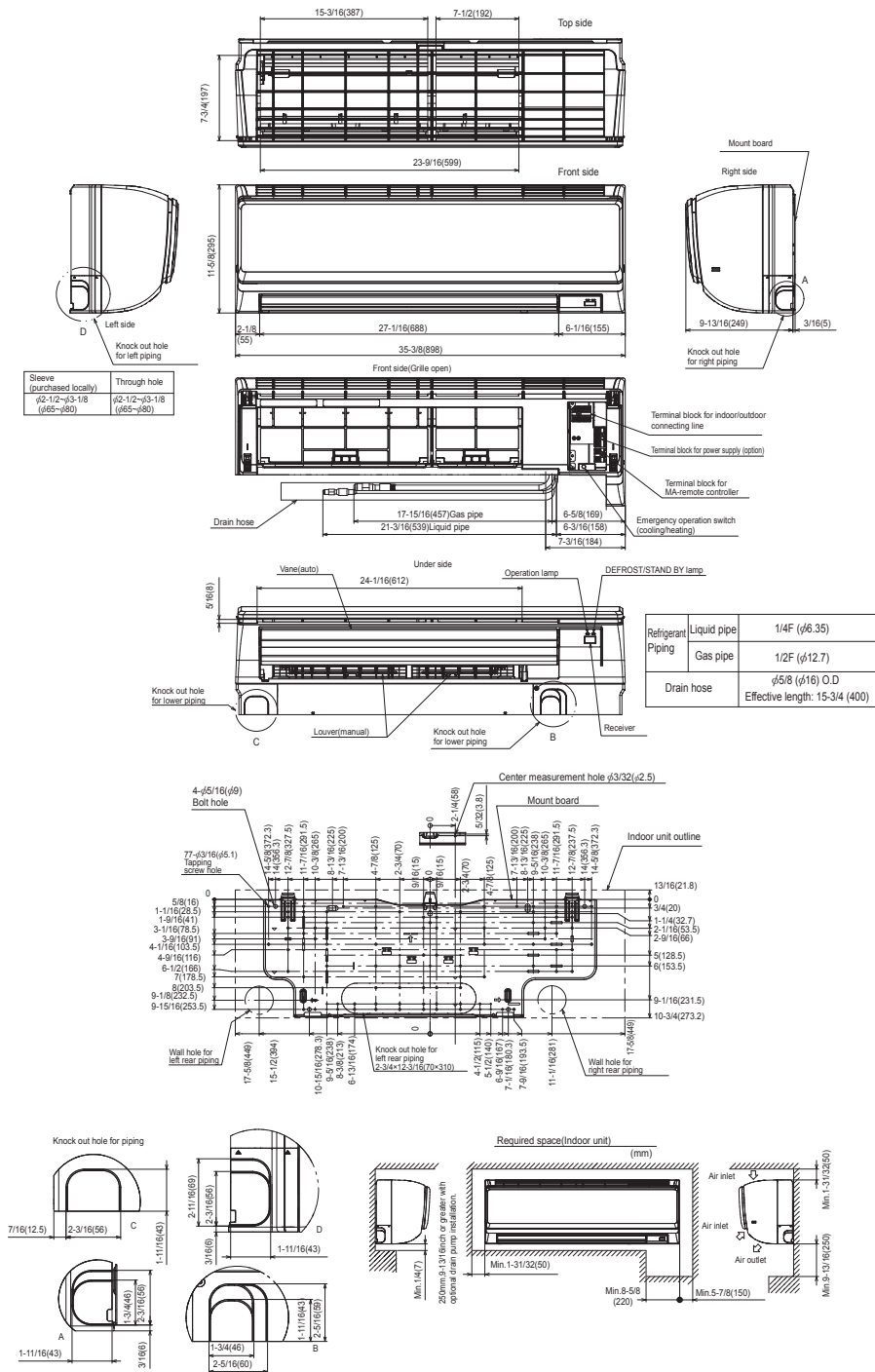
ACCESSORIES: PUY-A12NKA7(-BS)

Air Outlet Guide	<input type="checkbox"/> PAC-SJ07SG-E
Front Wind Baffle	<input type="checkbox"/> WB-PA4
Side Advanced Wind Baffle	<input type="checkbox"/> WB-SD4
Rear Advanced Wind Baffle	<input type="checkbox"/> WB-RE4
Drain Socket	<input type="checkbox"/> PAC-SJ08DS-E
Centralized Drain Pan	<input type="checkbox"/> PAC-SG63DP-E
M-NET Converter	<input type="checkbox"/> PAC-SJ19MA-E
M-NET Converter	<input type="checkbox"/> PAC-SJ96MA-E
Control/Service Tool	<input type="checkbox"/> PAC-SK52ST
Hail Guard	<input type="checkbox"/> HG-A5
Condensing Unit Mounting Pad 16" x 36" x 3"	<input type="checkbox"/> ULTRILITE1
Outdoor Unit Stand—12" High	<input type="checkbox"/> QSMS1201M
Outdoor Unit Stand—18" High	<input type="checkbox"/> QSMS1801M
Outdoor Unit Stand—24" High	<input type="checkbox"/> QSMS2401M
Heavy Duty Wall Mounting Bracket for Outdoor Units—Coated Steel	<input type="checkbox"/> QSWB2000M-1
Heavy Duty Wall Mounting Bracket for Outdoor Units—316 Series Stainless Steel	<input type="checkbox"/> QSWBSS
1/4" x 1/2" x 15' / 1/2" Lineset (Twin-Tube Insulation)	<input type="checkbox"/> MLS141212T-15
1/4" x 1/2" x 30' / 1/2" Lineset (Twin-Tube Insulation)	<input type="checkbox"/> MLS141212T-30
1/4" x 1/2" x 50' / 1/2" Lineset (Twin-Tube Insulation)	<input type="checkbox"/> MLS141212T-50
1/4" x 1/2" x 65' / 1/2" Lineset (Twin-Tube Insulation)	<input type="checkbox"/> MLS141212T-65
1/4" x 1/2" x 100' / 1/2" Lineset (Twin-Tube Insulation)	<input type="checkbox"/> MLS141212T-100

DIMENSIONS: PKA-A12HA7 & PUY-A12NKA7 (-BS)

PKA-A12HA7

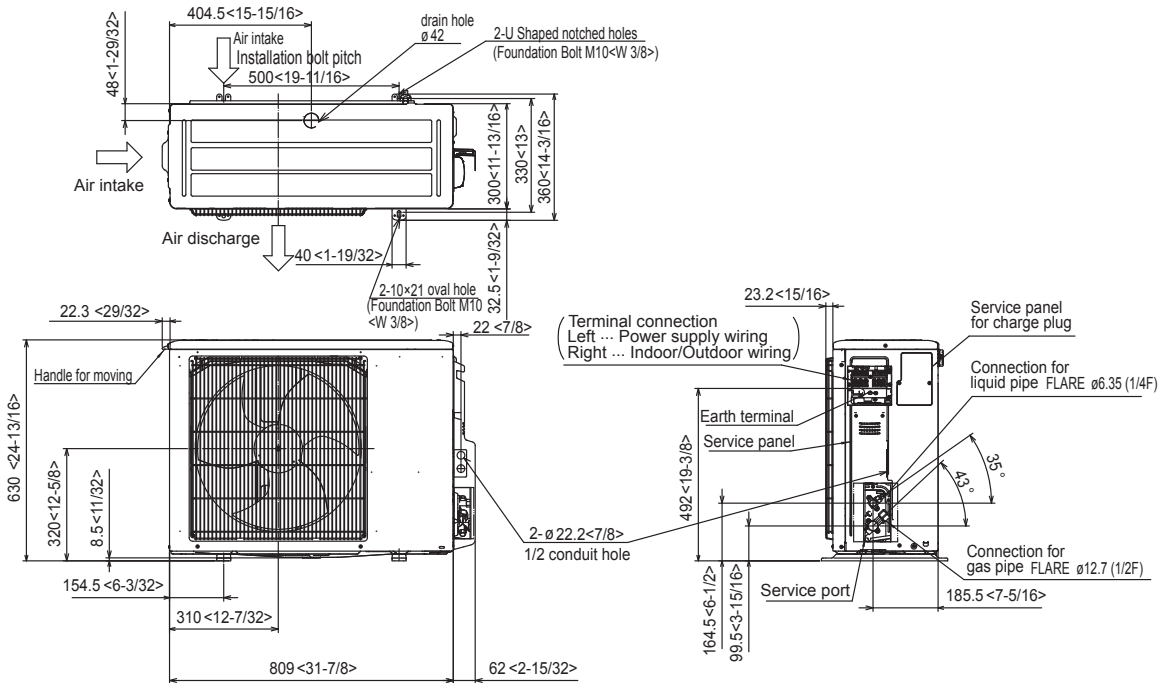
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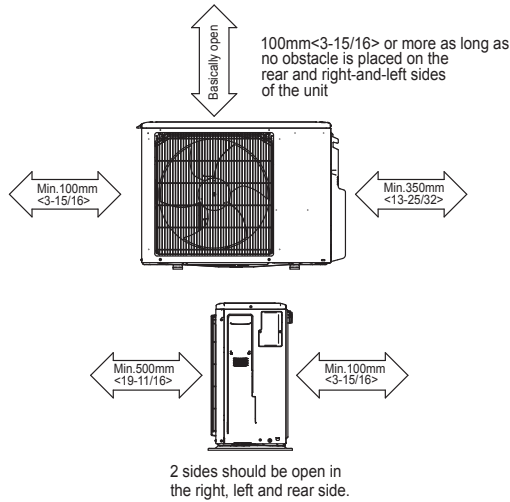
DIMENSIONS: PKA-A12HA7 & PUY-A12NKA7 (-BS)

PUY-A12NKA7(-BS)

Unit: mm<in>



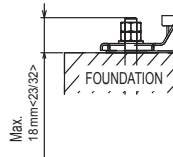
Free space around the outdoor unit (basic example)



FOUNDATION BOLTS

Please secure the unit firmly with 4 foundation (M10<W3/8>) bolts. (Bolts, washers and nut must be purchased locally).

<Foundation bolt height>



PIPING-WIRING DIRECTION

Piping and wiring connection can be made from the rear direction only.



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Job Name:

System Reference:

Date:

Indoor Unit:
PKA-A24KA7

Outdoor Unit:
 PUY-A24NHA7
 PUY-A24NHA7-BS



INDOOR UNIT FEATURES

- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES

- Variable speed INVERTER-driven compressor
- Power receiver pre-charged with refrigerant volume for piping length up to 100 ft (70 ft. for A12/18/24/30)
- Low ambient cooling down to -40°F providing 100% capacity (only for PUY models with wind baffles installed)
- 24-hour continuous operation (cooling mode)
- High pressure protection
- Fast restarts in cooling mode (15 seconds for 12/18/36/42; 50 seconds for 24/30)
- Superior energy and operational efficiency

SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

Model Number	Indoor Unit		PKA-A24KA7
	Outdoor Unit		PUY-A24NHA7
			PUY-A24NHA7-BS
Cooling ¹	Maximum Capacity	Btu/h	24,000
	Rated Capacity	Btu/h	24,000
	Minimum Capacity	Btu/h	10,000
	Maximum Power Input	W	1,960
	Rated Power Input	W	1,960
	Moisture Removal	Pints/h	5.0
	Sensible Heat Factor		0.77
	Power Factor	%	95.7
Efficiency	SEER		21.4
	EER ¹		12.2
Electrical	Voltage, Phase, Frequency		208 / 230V, 1-phase, 60 Hz
	Guaranteed Voltage Range	V AC	198 – 253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208 / 230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Voltage: Indoor - Remote controller	V DC	12
	Recommended Fuse/Breaker Size	A	25
	Recommended Wire Size (Indoor - Outdoor)	AWG	14
Indoor Unit	MCA	A	1
	Fan Motor Full Load Amperage	A	0.36
	Fan Motor Output	W	56
	Airflow Rate, Dry	CFM	635-705-775
	Airflow Rate, Wet	CFM	570-635-700
	External Static Pressure	in.WG	n/a
	Sound Pressure Level	dB(A)	39-42-45
	Drain Pipe Size	In. (mm)	5/8 (16)
	Condensate Lift Mechanism, Max. Distance	In. (mm)	n/a
	Heat Exchanger Type		Plate fin coil
	External Finish Color		White Munsell 1.0Y 9.2/0.2
	Unit Dimensions	W: In. (mm)	46-1/16 (1170)
		D: In. (mm)	11-5/8 (295)
		H: In. (mm)	14-3/8 (365)
	Package Dimensions	W: In.	51
		D: In.	18-8/16
H: In.		14-4/16	
Unit Weight	Lbs. (kg)	46 (21)	
Package Weight	Lbs.	53	
Indoor Unit Operating Temperature range	Cooling Intake Air Temp (Maximum / Minimum)	°F	90 DB, 73 WB / 66 DB, 59 WB

SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

Model Number	Indoor Unit		PKA-A24KA7	
	Outdoor Unit		PUY-A24NHA7	
			PUY-A24NHA7-BS	
Outdoor Unit	MCA	A	19	
	MOCP	A	26	
	Fan Motor Full Load Amperage	A	0.40	
	Fan Motor Output	W	86	
	Airflow Rate	CFM	1,940	
	Refrigerant Control	Electronic Expansion Valve		
	Heat Exchanger Type	Cross fin		
	Sound Pressure Level, Cooling ¹	dB(A)	47	
	Compressor Type	INVERTER-driven twin rotary		
	Compressor Model	SNB172FWHM1		
	Compressor Rated Load Amps	A	7	
	Compressor Locked Rotor Amps	A	11	
	Compressor Oil Type // Charge	oz.	FV50S // 23	
	External Finish Color	Ivory Munsell 3Y 7.8/1.1		
	Base Pan Heater	n/a		
	Unit Dimensions	W: In. (mm)	37-13/32 (950)	
		D: In. (mm)	13 + 1-3/16 (330 + 30)	
		H: In. (mm)	37-1/8 (943)	
	Package Dimensions	W: In.	40-15/16	
		D: In.	17-11/16	
H: In.		40-11/16		
Unit Weight	Lbs. (kg)	151 (68)		
Package Weight	Lbs. (kg)	176 (80)		
Outdoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	115 DB / -40* DB	
Refrigerant	Type	R410A		
	Charge	Lbs, oz	7 lbs, 11 oz	
Piping	Gas Pipe Size O.D. (Flared)	In.(mm)	5/8 (15.88)	
	Liquid Pipe Size O.D. (Flared)	In.(mm)	3/8 (9.52)	
	Maximum Piping Length	Ft. (m)	225 (69)	
	Maximum Height Difference	Ft. (m)	100 (30)	
	Maximum Number of Bends	15		

SPECIFICATIONS: PKA-A24KA7 & PUY-A24NHA7(-BS)

Notes

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	¹ Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
<p>*Wind baffles required to operate below 23F DB in cooling mode. For PUY models, wind baffles can be utilized to extend the cooling operation range to -40F. Please refer to the wind baffle submittals to determine which baffles are required to meet the desired operation range.</p> <p>**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.</p>			
<p>SEACOAST PROTECTION</p> <ul style="list-style-type: none">• External Outer Panel: Phosphate coating + Acrylic-Enamel coating• Fan Motor Support: Epoxy resin coating (at edge face)• Separator Assembly; Valve Bed: Epoxy resin coating (at edge face)• "Blue Fin" treatment is an anti-corrosion treatment that is applied to the condenser coil to protect it against airborne contaminants.			

ACCESSORIES: PKA-A24KA7

Signal Receiver	□ PAR-SA9CA-E
Wireless Remote Controller	□ PAR-FL32MA-E
Wireless Remote Receiver	□ PAR-FA32MA-E
Backlit, Wall-mounted, Wireless Controller	□ MHK1
Portable Central Controller	□ MCCH1
Wired MA Controller	□ PAR-33MAA
Simple MA Controller	□ PAC-YT53CRAU
Touch MA Controller	□ PAR-CT01MAU-SB
Wired Remote Sensor	□ PAC-SE41TS-E
Lockdown Bracket for Wireless, Hand-held, Remote Controller	□ RCMKP1CB
Wireless Temperature and Humidity Sensor	□ PAC-USWHS003-TH-1
Outside Air Sensor for MHK1	□ MOS1
Flush Mount Remote Temperature Sensor	□ PAC-USSEN001-FM-1
Wireless Interface	□ PAC-USWHS002-WF-1
Thermostat Interface	□ PAC-US444CN-1
kumo station®	□ PAC-WHS01HC-E
USNAP Interface	□ PAC-WHS01UP-E
IT Extender	□ PAC-WHS01IE-E
BACnet® and MODBUS® Interface	□ PAC-UKPRC001-CN-1
Connector for CN32 (remote on/off)	□ PAC-SE55RA-E
External Drain Pump	□ PAC-KE07DM-E
External Drain Pump	□ PAC-SH94DM-E
Blue Diamond Sensor Extension Cable—15 Ft.	□ C13-103
Mini Condensate Pump—230V application	□ SI30-230
MegaBlue Advanced Blue Diamond Condensate Pump w/ Reservoir & Sensor	□ X87-835 - 110 to 250V
MaxiBlue Advanced Blue Diamond Mini Condensate Pump w/ Reservoir & Sensor (208/230V) up to 48,000 Btu/h [recommended]	□ X87-721 - 208/230V
Drain Pan Level Sensor (Control for indoor unit shut off to prevent drain pan overflow)	□ DPLS2
3 Pole Disconnect Switch (30A/600VUL) [fits 2"X4" utility] - Black	□ TAZ-MS303
3 Pole Disconnect Switch (30A/600VUL) [fits 2"X4" utility] - White	□ TAZ-MS303W

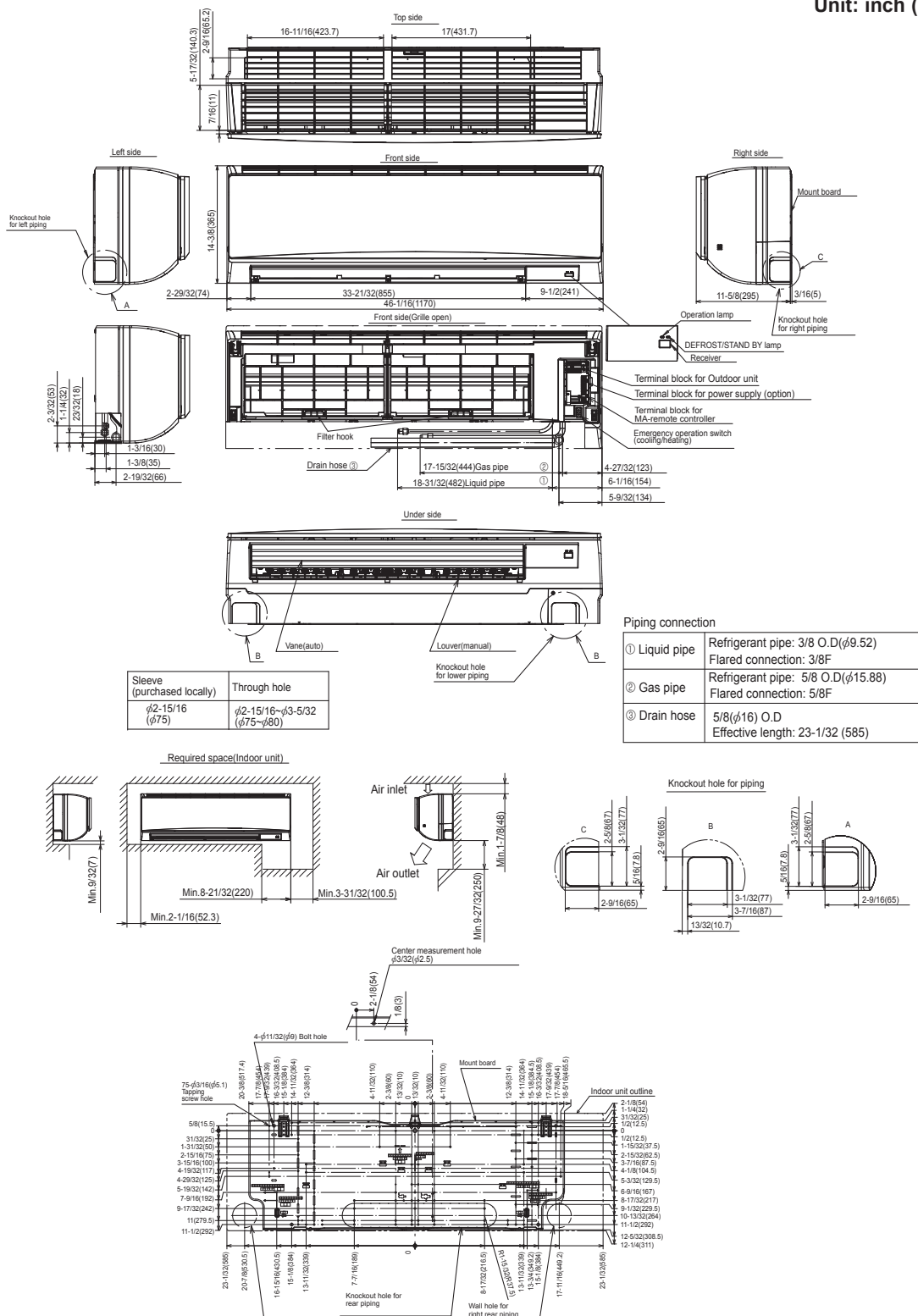
ACCESSORIES: PUY-A24NHA7(-BS)

Twining Distribution Pipe (50:50)	□ MSDD-50TR-E
Air Outlet Guide	□ PAC-SG59SG-E
Front Wind Baffle	□ WB-PA5
Side Advanced Wind Baffle	□ WB-SD5
Rear Advanced Wind Baffle	□ WB-RE5
Drain Socket	□ PAC-SG61DS-E
Centralized Drain Pan	□ PAC-SG64DP-E
M-NET Converter	□ PAC-SF83MA-E
M-NET Converter	□ PAC-SJ95MA-E
Control/Service Tool	□ PAC-SK52ST
Hail Guard	□ HG-A6
Condensing Unit Mounting Pad 24" x 42" x 3"	□ ULTRILITE2
Outdoor Unit Stand—12" High	□ QSMS1201M
Outdoor Unit Stand—18" High	□ QSMS1801M
Outdoor Unit Stand—24" High	□ QSMS2401M
Heavy Duty Wall Mounting Bracket for Outdoor Units—Coated Steel	□ QSWB2000M-1
Heavy Duty Wall Mounting Bracket for Outdoor Units—316 Series Stainless Steel	□ QSWBSS
3/8" x 5/8" x 10' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-10
3/8" x 5/8" x 15' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-15
3/8" x 5/8" x 30' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-30
3/8" x 5/8" x 50' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-50
3/8" x 5/8" x 65' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-65
3/8" x 5/8" x 100' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-100

DIMENSIONS: PKA-A24KA7 & PUY-A24NHA7 (-BS)

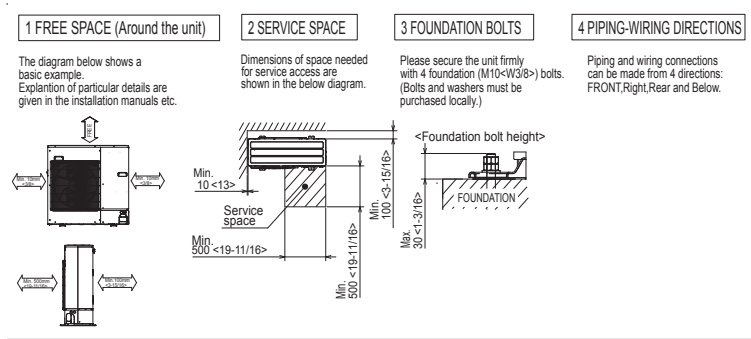
PKA-A24KA7

Unit: inch (mm)

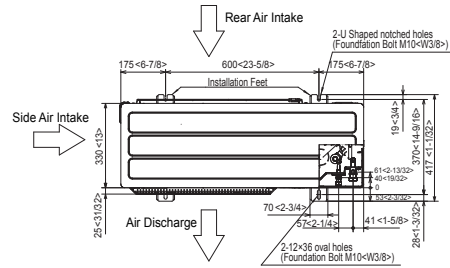


DIMENSIONS: PKA-A24KA7 & PUY-A24NHA7 (-BS)

PUY-A24NHA7(-BS)

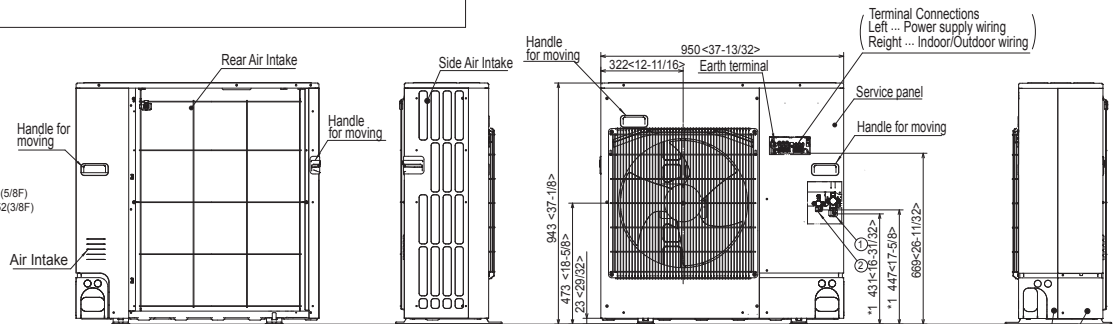


Unit: mm<in>

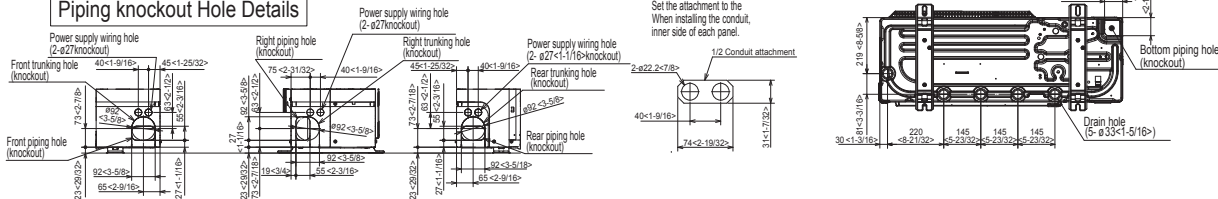


Example of Notes

- ① ... Refrigerant GAS pipe connection (FLARE) $\phi 15.88(5/8)$ F
- ② ... Refrigerant LIQUID pipe connection (FLARE) $\phi 9.52(3/8)$ F
- *1... Indication of STOP VALVE connection location.



Piping knockout Hole Details



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Job Name:	Date:
System Reference:	



GENERAL FEATURES

- Dual set point functionality
- Compact, lightweight, shiny-white, flat-panel design
- Quiet operation
- Multiple fan-speed settings
- Intake grille filter is easily removed for cleaning
- Wireless receiver on board

OPTIONS

- Condensate Pump.....SI3100-230
- External Heat Adapter.....PAC-725AD
- CN24 Relay Kit.....CN24RELAY-KIT-CM3

SPECIFICATIONS

Capacity*

Cooling.....6,000 Btu/h
 Heating.....6,700 Btu/h

Power

Power Source.....208 / 230V, 1-phase, 60Hz

Power Consumption

Cooling.....0.03 kW
 Heating.....0.03 kW

Current

Cooling.....0.15 A
 Heating.....0.15 A
 Minimum Circuit Ampacity (MCA).....0.19 A
 Maximum Overcurrent Protection (MOCP) Fuse.....15 A

External Finish.....Munsell No. 1.0Y 9.2 / 0.2

External Dimensions

Inches.....11-5/8 H x 32-1/8 W x 8-7/8 D
 mm.....295 H x 815 W x 225 D

Net Weight

Unit.....22 lbs. / 10 kg

Coil Type.....Cross Fin
 (Aluminum Plate Fin and Copper Tube)

Fan

Type x Quantity.....Line Flow Fan x 1
 Airflow Rate (Low-Mid1-Mid2-High).....170 - 180 - 200 - 210 CFM
 Motor Type.....One-phase Induction Motor

Air Filter.....Polypropylene Honeycomb

Refrigerant Piping Dimensions

Liquid (High Pressure).....1/4" / 6.35 mm (Flare)
 Gas (Low Pressure).....1/2" / 12.7 mm (Flare)

Drainpipe Dimension.....I.D. 5/8" / 16 mm

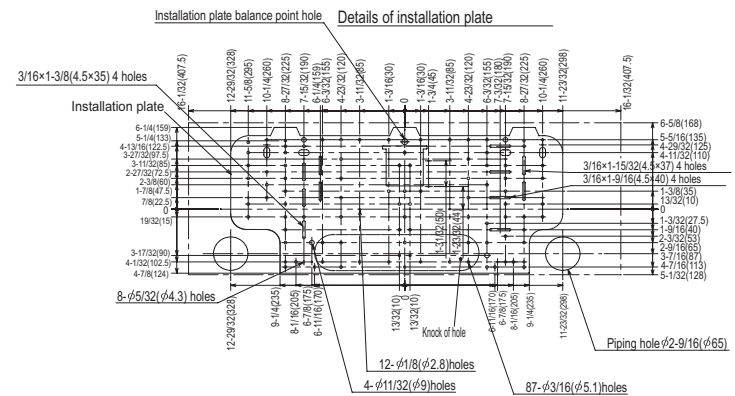
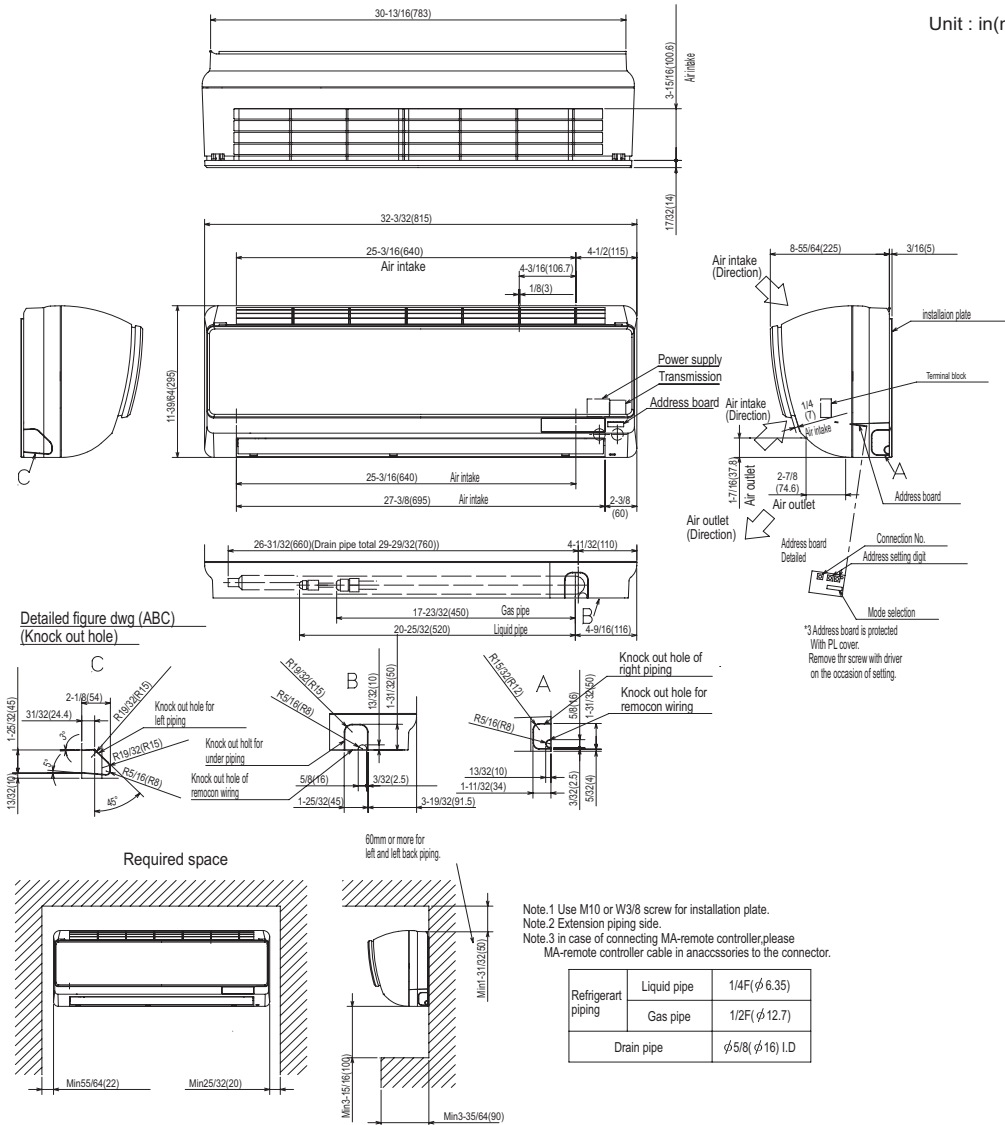
Sound Pressure Levels

Low-Mid1-Mid2-High.....32 - 33 - 35 - 36 dB(A)

* Cooling / Heating capacity indicated at the maximum value at operation under the following conditions:
 Cooling | Indoor: 80° F (27° C) DB / 67° F (19° C) WB,
 Cooling | Indoor: Outdoor 95° F (35° C) DB
 Heating | Indoor: 70° F (21° C) DB,
 Heating | Outdoor 47° F (8° C) DB / 43° F (6° C) WB

Model: PKFY-P06NBMUE2R1 – DIMENSIONS

Unit : in(mm)



COOLING & HEATING

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Job Name:

System Reference:

Date:

Indoor Units:

					
PEA-A12,18AA6	PEAD-A12,18AA7	PLA-A12,18BA6	PLA-A12,18EA7	PKA-A12,18	PVA-A12,18AA7

Outdoor Units:

			
PUY/PUZ-A24, 36NHA6 PUY/PUZ-A24, 36NHA6-BS	PUY/PUZ-A24NHA7 PUY/PUZ-A24NHA7-BS	PUY/PUZ-36NKA7 PUY/PUZ-36NKA7-BS	PUZ-HA36NHA5

GENERAL FEATURES

- Through twinning, operate two indoor units from one outdoor unit—ideal for single area and unusually shaped rooms/zones or long narrow rooms/zone applications
- One hard-wired, wall-mounted PAR-33MAA or Simple MA remote controller simultaneously controls both indoor units
- Supply power wiring is connected to the outdoor unit power supply terminals
- A-Control: Wire from S1-S2-S3 on the outdoor unit directly to indoor unit 1 and then to indoor unit 2
- Control signal is transmitted between outdoor unit and both indoor units via data over the power connections
- Required Accessory for Combining Indoor Units: MSDD-50TR-E Distribution Pipe Kit (includes one distribution pipe each for liquid and gas, and choice of joint adapters)

TWINNING REQUIREMENTS

Outdoor Units	Indoor Units x 2		
PUY/PUZ-A24NHA6	PEA-A12AA6	PKA-A12HA6	PLA-A12BA6
PUY/PUZ-A36NHA6	PEA-A18AA6	PKA-A18HA6	PLA-A18BA6
PUZ-HA36NHA5	PEA-A18AA6	PKA-A18HA6	PLA-A18BA6

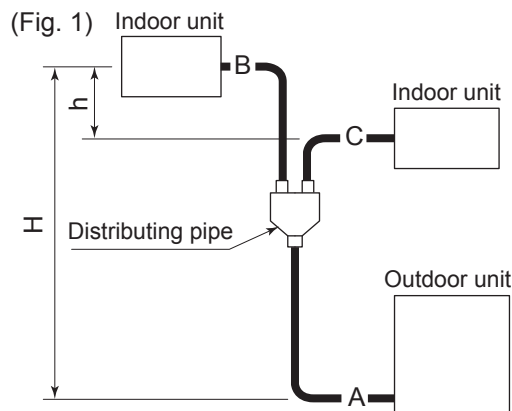
Outdoor Units	Indoor Units x 2			
PUY/PUZ-A24NHA7	PEAD-A12AA7	PKA-A12HA7	PLA-A12EA7 ¹	PVA-A12AA7
PUY/PUZ-A36NKA7	PEAD-A18AA7		PLA-A18EA7 ¹	
PUZ-HA36NHA5	PEAD-A18AA7	PKA-A18HA7	PLA-A18EA7 ¹	PVA-A18AA7

¹ Refer to the piping length limitation

Please refer to Twinning Application Piping Information for special case rules.

PIPE SIZE AND LIMIT TO REFRIGERANT PIPE

Actual pipe length (m)		Height Difference (m)		*2 Number of bends
Indoor-Outdoor	A + B + C =	Indoor-Indoor	Indoor-Outdoor	
-	165 ft (50m) or less	$ B - C =$ 26 ft (8m) or less	H = 98 ft (30m) or less	15 or less
	245 ft (75m) or less		h = 3 ft (1m) or less	



*2 Limit the number of bends for refrigerant pipes to 8 in each of the (A+B) and (A+C) ranges.

See the installation manual provided with the main unit for details on chargeless pipe length and refrigerant additional charge amount.

TWINNING APPLICATION PIPING INFORMATION

- Maximum total piping length for PUY/PUZ-A24,36:
 - with 2x PLA-A12EA7 is 59 ft (18m)
 - with 2x PLA-A18EA7 is 98 ft (30m)
 - All other combinations is 165 ft (50m)
- Maximum total piping length for PUZ-HA36 Outdoor Units: 245 ft (75m)
- Maximum height difference from IDU to IDU: 3 ft (1m)
Maximum length difference from IDU to IDU: 26 ft (8m)
- Maximum height difference from ODU to IDUs: 100 ft (31m); note: piping lengths to each IDU unit do not have to be equal
- For the NHA6 generation: both IDUs must have the same capacity, but do not have to be the same style. (PEA, PEAD, PKA, PLA, and PVA IDUs can be combined for one system.
For the NH/KA7 generation, the same indoor unit types must be used.
- Twinned IDUs operate simultaneously only; individual IDU control is not available
- One PAR-33MAA remote controller controls both IDUs simultaneously
- Temperature setpoint is set from the PAR-33MAA, choose one of three options on the controller to set the temperature sensing
 - Average of the data from both IDU return air sensors (factory setting)
 - Data from the return air sensor in the IDU directly connected to the PAR-33MAA
 - Data from the sensor in the PAR-33MAA only
- ODU is automatically controlled using Mitsubishi Electric's INVERTER Technology; compressor, frequency, and LEV position will be adjusted as needed to maintain selected room conditions
- Refer to P-Series Installation or Technical Service Manuals for wiring diagrams



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Job Name:

System Reference:

Date:



OUTDOOR VRF
HEAT RECOVERY
SYSTEM

UNIT OPTION

- Standard Model.....PURY-EP72TNU-A
- Seacoast (BS) Model.....PURY-EP72TNU-A-BS

ACCESSORIES

- Joint Kit.....for details see Pipe Accessories Submittal
- BC Controller (required).....for details see BC Controller Submittals
- Low Ambient Kit.....for details see Low Ambient Kit Submittal
- Snow/Hail Guards Kit.....for details see Snow/Hail Guards Kit Submittal
- Panel Heater Kit.....for details see Panel Heater Kit Submittal

Specifications		Model Name
Unit Type		PURY-EP72TNU-A (-BS)
Nominal Cooling Capacity	Btu/h	72,000
Nominal Heating Capacity	Btu/h	80,000
Guaranteed Operating Range *1	Cooling (Outdoor) *2	23~126°F (-5~52°C)
	Heating (Outdoor) *3	-13~60°F (-25~15.5°C)
Extended Operating Range *4	Heating (Outdoor)	-25~60°F (-31.5~15.5°C)
External Dimensions (H x W x D)	In. (mm)	71-5/8 x 36-1/4 x 29-5/32 (1,818 x 920 x 740)
Net Weight	Lbs. (kg)	519 (235)
External Finish		Pre-coated galvanized steel sheet (+powder coating for -BS type) <MUNSELL 5Y 8/1>
Electrical Power Requirements	Voltage, Phase, Hertz	3-phase 3-wire 208-230 V ±10% 60 Hz
Minimum Circuit Ampacity (MCA, 208/230V)	A	23/21
Maximum Overcurrent Protection (MOP, 208/230V)	A	35/30
Recommended Fuse Size (208/230V)	A	35/30
Recommended Minimum Wire Size (208/230V)	AWG (mm)	8 (8.4) / 10 (5.3)
Short-circuit Current Rating (SCCR)	kA	5
Piping Diameter (Brazed) (In. / mm)	Liquid (High Pressure)	5/8 (15.88) Brazed
	Gas (Low Pressure)	3/4 (19.05) Brazed
Max. Total Refrigerant Line Length	Ft.	1,804
Max. Refrigerant Line Length (Between ODU & IDU)	Ft.	541
Max. Control Wiring Length	Ft.	1,640
Indoor Unit	Total Capacity	50~150% of outdoor unit capacity
	Model / Quantity	P05~P96/1~18
Sound Pressure Levels	dB(A)	56.5/58.0
Sound Power Levels	dB(A)	75.5/77.0
Fan	Type x Quantity	Propeller fan x 1
	Airflow Rate	CFM
	External Static Pressure	In. WG
Compressor Operating Range		15% to 100%
Compressor Type x Quantity		Inverter scroll hermetic compressor x 1
Refrigerant		R410A 11 lbs + 7 oz (5.2 kg)
Protection Devices	High Pressure	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)
	Inverter Circuit (Comp. / Fan)	Over-heat protection, Over-current protection
	Fan Motor	Over-current protection
AHRI Ratings (Ducted/Non-Ducted)	EER	13.4 / 15.4
	IEER	24.5 / 31.2
	COP	3.81 / 4.37
	SCHE	25.9 / 25.5

NOTES:
 Nominal cooling conditions (Test conditions are based on AHRI 1230) Indoor: 80°FDB./67°FWB. (26.7°CDB./19.4°CWB.), Outdoor: 95°FDB. (35°CDB.)
 Nominal heating conditions (Test conditions are based on AHRI 1230) Indoor: 70°FDB. (21.1°CDB.), Outdoor: 47°FDB./43°FWB. (8.3°CDB./6.1°CWB.)

- Harsh weather environments may demand performance enhancing equipment. Ask your Mitsubishi Electric representative for more details about your region
- For details on extended cooling operation range down to -10° F DB, see Low Ambient Kit Submittal
- When applying product below -4°F, consult your design engineer for cold climate application best practices, including the use of a backup source for heating
- Unit will continue to operate in extended operating range, but capacity is not guaranteed

Model: PURY-EP72TNU-A (-BS) – DIMENSIONS

2. EXTERNAL DIMENSIONS

R2-Series (High efficiency)

PURY-EP-T(S)NU-A, Y(S)NU-A

PURY-EP72TNU-A(-BS)

Unit: mm(in)

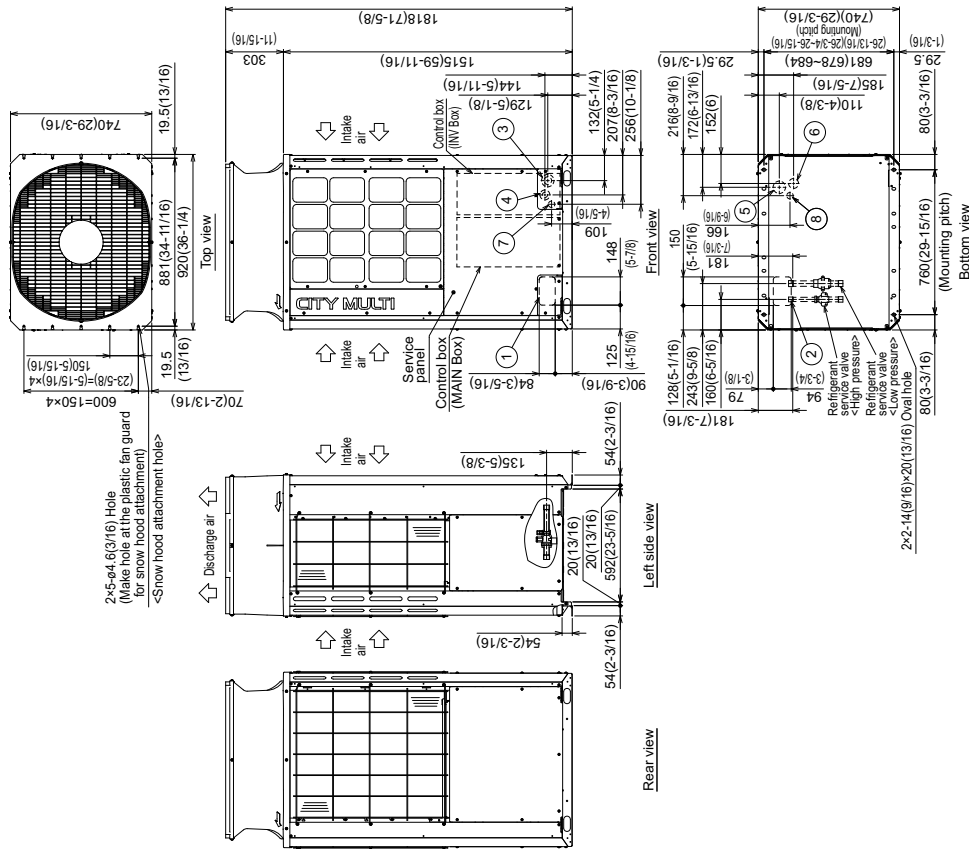
Note 1. Please refer to the next page for information regarding necessary spacing around the unit and foundation work.
2. At brazing of pipes, wrap the refrigerant service valve with wet cloth and keep the temperature of refrigerant service valve under 120°C(248°F).

Connecting pipe specifications

Model	Refrigerant pipe		Service valve	
	High pressure	Low pressure	High pressure	Low pressure
EP72	φ15.88(3/8) Standard 1	φ11.03(3/4) Standard 1	φ2.7(8)	φ3.3(1-1/8)

*1 Connect the refrigerant pipe to the service valve according to the installation Manual.

No.	Usage	Specifications
①	Front through hole	146(5-7/8) x 94(3-5/8) Knockout hole
②	Bottom through hole	150(5-5/8) x 94(3-5/8) Knockout hole
③	Front through hole	ø62.7(2-1/2) for ø34.8(1-3/8) Knockout hole
④	Front through hole	ø43.7(1-3/4) for ø22.8(7/8) Knockout hole
⑤	Bottom through hole	ø65.2(2-1/8) Knockout hole
⑥	Bottom through hole	ø52.2(2-1/8) Knockout hole
⑦	Front through hole	ø34(1-3/8) Knockout hole
⑧	Bottom through hole	ø34(1-3/8) Knockout hole



NOTES:

SEACOAST PROTECTION

- Anti-corrosion Protection: A coating treatment is applied to condenser coil for protection from air contaminants.
- Standard: Salt Spray Test Method - no unusual rust development to 480 hours.
- Sea Coast (BS): Salt Spray Test Method (JRA 9002) - no unusual rust development to 960 hours.



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FORM# PURY-EP72TNU-A (-BS) - 201912

Specifications are subject to change without notice.



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Job Name:	
System Reference:	Date:



PVFY-P48NAMU-E1

GENERAL FEATURES

- Multi-position design is suitable for any application requires no additional kits, even for downflow configuration
- Dual set point functionality
- Designed specifically for use with CITY MULTI® outdoor units
- Choice of three fan speeds for optimum comfort
- Highly efficient DC motor and a forward curved blower ensures quiet, consistent fan operation
- Optional relay kit provides functionality for two stage auxiliary heat (1 kit per stage), humidifier integration, or other custom applications
- Control board includes a condensate overflow switch connection
- Heavy-gauge steel cabinets with 1" fiberglass-free foam insulation with an R-4.2 insulation value
- Suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition
- Tested in accordance with ANSI/ASHRAE Standard 193; less than 1% air leakage at maximum airflow

ACCESSORIES:

- Relay Kit.....CN24RELAY-KIT-CM3
- Fan Speed Indication Adapter.....PAC-735
- Electric Heat Kit.....for details see Electric Heat Kit Submittal

SPECIFICATIONS:

Capacity*		
Cooling	Btu/h	48,000
Heating	Btu/h	54,000

* Cooling / Heating capacity indicated at the maximum value at operation under the following conditions:
 Cooling | Indoor : 80° F (27° C) DB / 67° F (19° C) WB
 Cooling | Outdoor : 95° F (35° C) DB
 Heating | Indoor : 70° F (21° C) DB
 Heating | Outdoor : 47° F (8° C) DB / 43° F (6° C) WB

Electrical		
Electrical Power Requirements	1-phase, 208 / 230V, 60Hz	
Minimum Circuit Ampacity (MCA)	A	5.63 / 5.63
Maximum Fuse Size	A	15

External Dimensions		
Height	In.(mm)	59-1/2 (1,511)
Width	In.(mm)	25 (635)
Depth	In.(mm)	21-5/8 (548)

Net Weight	Lbs.(kg)	172 (78)
External Finish	High-gloss polyester powder coated	
Coil Type	Cross Fin (Aluminum Plate Fin and Copper Tube)	

Fan		
Type x Quantity	Sirocco fan x 1	
Airflow rate (Low - Mid - High)	CFM	980 - 1,190 - 1,400
External Static Pressure	In. WG	0.30 / 0.50 / 0.80 (Selectable)
Motor Type	DC motor	

Air Filter	Polypropylene Honeycomb	
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Refrigerant Piping Diameter		
Liquid (High Pressure)	In.(mm)	3/8 (9.52) Brazed
Gas (Low Pressure)	In.(mm)	5/8 (15.88) Brazed

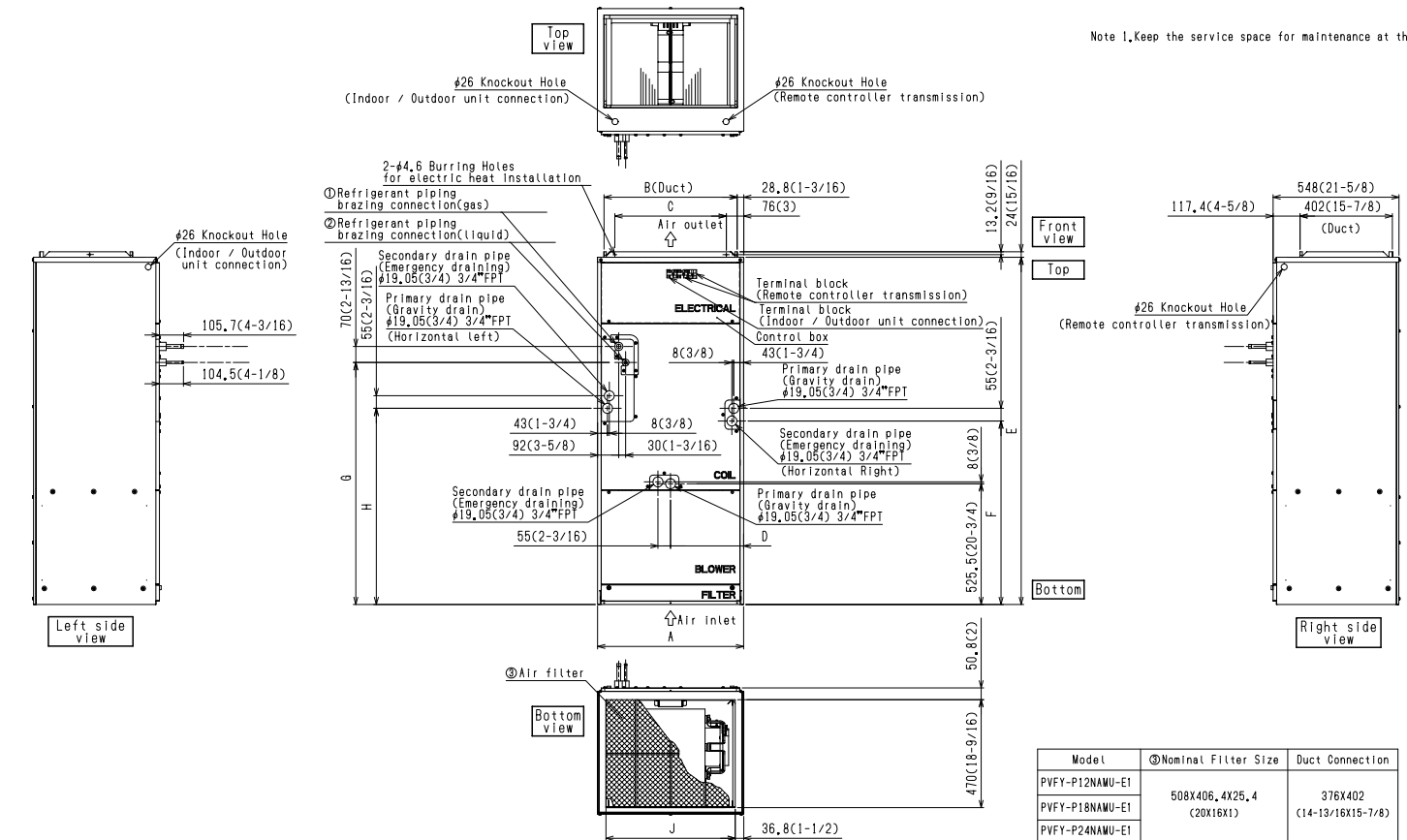
Field Drain Pipe Size	In.(mm)	FPT 3/4 (19.05)
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Sound Data (Low - Mid - High) (measured in anechoic room)		
Sound Pressure Level	dB(A)	35 - 39 - 43

Model: PVFY-P48NAMU-E1 – DIMENSIONS

Units: mm (in.)

Note 1. Keep the service space for maintenance at the front.



Model	A	B	C	D	E	F	G	H	J	①Gas pipe	②Liquid pipe
PVFY-P12NAMU-E1	432	376	281	224	1275	680	823	735,5	360	①12,7 (1/2)	②6,35 (1/4)
PVFY-P18NAMU-E1	(17)	(14-13/16)	(11-1/8)	(8-7/8)	(50-1/4)	(26-13/16)	(32-7/16)	(29)	(14-3/16)		
PVFY-P24NAMU-E1											
PVFY-P30NAMU-E1	534	477	382,6	266,5	1378	737	953,5	792	461	①15,88 (5/8)	②9,52 (3/8)
PVFY-P36NAMU-E1	(21)	(18-13/16)	(15-1/8)	(10-1/2)	(54-1/4)	(29-1/16)	(37-9/16)	(31-3/16)	(18-3/16)		
PVFY-P48NAMU-E1	635	579	484,6	317,5	1511	798,5	1053	853,5	563		
PVFY-P54NAMU-E1	(25)	(22-13/16)	(19-1/8)	(12-1/2)	(59-1/2)	(31-7/16)	(41-1/2)	(33-5/8)	(22-3/16)		

Model	③Nominal Filter Size	Duct Connection
PVFY-P12NAMU-E1	508X406, 4X25, 4 (20X16X1)	376X402 (14-13/16X15-7/8)
PVFY-P18NAMU-E1		
PVFY-P24NAMU-E1		
PVFY-P30NAMU-E1	508X508X25, 4 (20X20X1)	477X402 (18-13/16X15-7/8)
PVFY-P36NAMU-E1		
PVFY-P48NAMU-E1	508X609, 6X25, 4 (20X24X1)	579X402 (22-13/16X15-7/8)
PVFY-P54NAMU-E1		



COOLING & HEATING

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Ceiling Exhaust Fan Model SP-AP

Bathroom Exhaust Fans

Greenheck's SP ceiling exhaust fan line is better than ever!

- **Flexibility** - Virtually silent EC motors allow for three built-in high speed airflow settings of 50, 80 and 110 cfm for flexibility in most applications. The universal duct connector allows for quick connections to 4-, 5- and 6-inch ducting.
- **Performance Under Pressure** - Constant CFM technology provides guaranteed airflow to over .375 in. wg. This improves indoor air quality, reduces callback and eliminates issues during test and balance.
- **Plug and Play Customization** - Optional humidity, motion, nightlight, and CO₂ sensor modules clip into the fan, creating countless combinations.
- **Energy Efficiency** - Recognized as the "Most Efficient of Energy Star® 2019".
- **Code Compliance** - Standard two speed (commonly known as whole house ventilation) operation provides tools to help meet ASHRAE 62.2, WSEC and CAL Title 24 requirements.
- **Installation and Retrofit** - Installs without the need for attic or above the ceiling access. Makes installation in new construction and retrofits easy and simple.



SP-AP0511W



SP-AP0511WL (lighted)

Plug and Play Accessories

Humidity Sensor – Controlling humidity in bathrooms is critical to helping improve Indoor Air Quality (IAQ). The simple, snap in, plug and play humidity sensor has adjustable sensitivity (30-80% RH) and will run the fan when humidity levels are high.

Motion Sensor – Forgetting to turn on the fan can cause poor IAQ by not eliminating moisture and odor. The plug and play motion sensor automatically runs the fan when someone walks in the room. Once the sensor no longer detects motion, the fan runs for a short period of time, then returns to low speed.

Night Light – The plug and play night light offers a low-intensity LED light that provides enough light for using the bathroom at night without turning on the main light. A night light is available as an optional plug and play accessory on the SP-AP0511W and is standard on the SP-AP0511WL.

CO₂ – High CO₂ levels have been linked to headaches, dizziness, tiredness and general discomfort. When CO₂ concentrations exceed 1000 PPM the fan will turn on until CO₂ levels are below 800 PPM.



Performance

Model	Energy Star®	CFM Selection	RPM	Max Amps	Max Watts	CFM/Static Pressure in Inches wg								
						0	0.1	0.125	0.25	0.375	0.5	0.625		
SP-AP0511W	☆	50	820	0.24	16.5	CFM	50	50	50	50	50	50	50	
						Sones	<0.3	<0.3	<0.3	0.6	1.5	2.5	3.0	
						CFM/Watt	20.1	11.0	9.9	6.8	4.9	4.0	3.3	
						Watts	3.0	4.9	5.5	8.1	11.3	14.3	16.5	
		80	831	0.26	18.1	CFM	80	80	80	80	80	80	80	60
						Sones	<0.3	<0.3	<0.3	0.7	1.4	2.0	3.0	
						CFM/Watt	18.6	12.5	11.5	8.2	5.9	4.8	3.5	
						Watts	4.7	6.8	7.4	10.5	14.7	18.1	17.1	
		110	861	0.30	20.1	CFM	110	110	110	110	110	105	58	
						Sones	0.4	0.4	0.5	0.8	1.3	2.0	3.0	
						CFM/Watt	16.1	11.3	11.3	8.2	6.2	5.2	3.4	
						Watts	7.4	10.6	10.6	14.8	20.1	20.1	16.9	
SP-AP0511WL	☆	50	819	0.24	16.3	CFM	50	50	50	50	50	50		
						Sones	<0.3	<0.3	<0.3	1.0	2.0	3.0	3.0	
						CFM/Watt	19.6	11.5	10.1	6.8	5.2	4.1	3.4	
						Watts	3.1	4.8	5.4	8.2	10.8	14.3	16.3	
		80	861	0.25	17.0	CFM	80	80	80	80	80	80	55	
						Sones	<0.3	<0.3	<0.3	0.9	1.5	2.5	3.5	
						CFM/Watt	17.4	12.2	11.3	7.9	5.9	4.7	3.4	
						Watts	5.1	7.0	7.7	11.2	14.6	17	16.4	
		110	934	0.31	20.4	CFM	110	110	110	110	110	77	55	
						Sones	0.5	0.7	0.7	1.2	2.0	2.5	3.5	
						CFM/Watt	15	10.7	8.4	6.8	5.7	3.4	1.6	
						Watts	7.9	10.8	11.4	15.7	20.4	16.9	16.4	



SP-AP0511W and SP-AP0511WL are recognized as the Most Efficient of ENERGY STAR® 2019



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www.hvi.org

Air and Sound Certified at
.1, .25 and .375 in. wg

Our Commitment

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Green Building Efforts



Centrifugal Inline Fans Models SQ and BSQ

Direct and Belt Drive



VARI GREEN Motor



 **GREENHECK**
Building Value in Air.

May
2013

Models SQ and BSQ

Centrifugal Square Inline Duct Fans



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Greenheck Fan Corporation certifies the model SQ and BSQ fans shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and Publication 311 and comply with the requirements of the AMCA Certified Ratings Program. The certified ratings for models SQ and BSQ are shown on pages 15 to 45.



UL is optional and must be specified. SQ and BSQ models are Listed for Electrical (UL/cUL 705) File no. E40001



Models SQ 100 and greater.
Models BSQ 70 through BSQ 420

For a CE compliant installation, all electrical connections must be made by a qualified electrician.



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- Greenheck has been Green for a long time! Our energy-saving products and ongoing corporate commitment to sustainability can help you qualify for LEED credits.
- Our 3D service allows you to download at no charge lightweight, easy-to-use AutoDesk™ Revit™ 3D drawings for many of our ventilation products.

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Models SQ and BSQ

Centrifugal Square Inline Duct Fans



Model Comparison																										
Model	Location		Mounting					Airflow				Application						Drive Type		Impeller Type			Performance		Relative Cost	
	Outdoor	Indoor	Roof Curb	Base/Floor	Hanging	Wall	Ceiling Mounted	Exhaust	Supply	Reversible	Recirculate	General/Clean Air	Contaminated Air	Spark Resistant	Grease (UL 762)	Smoke Control (UL)	High Wind (150 mph)	High Temp (above 200°F)	Belt	Direct	Centrifugal	Propeller/Axial	Mixed Flow	Maximum Volume (cfm)		Maximum Static Pressure (in. wg)
SQ		✓		✓	✓			✓	✓		✓	✓	✓							✓	✓			5,000	2	\$
BSQ		✓		✓	✓			✓	✓		✓	✓	✓						✓		✓			27,200	4	\$

Greenheck’s model SQ and BSQ centrifugal inline fans feature a unique combination of installation flexibility, rugged construction, ease of service, high efficiency and low sound levels. These compact inline fans are the ideal selection for indoor clean air applications including intake, exhaust, return or make-up air systems where space is a prime consideration. The need for costly square-to-round transition pieces is eliminated reducing installation costs. The square housing design, compact size and straight-thru airflow also give the system designer the flexibility to mount SQ and BSQ fans in any configuration - horizontal, vertical or at any angle.

- Broadest performance in the industry, up to 4 in. wg (1,000 Pa) and 28,000 cfm (47,000 m³/hr).
- Performance as cataloged is assured. All fan sizes are tested in our AMCA Accredited Laboratory, and all models are licensed to bear the AMCA Sound and Air Performance seals.
- UL Listed for Electrical.
- These Greenheck products are subjected to extensive life testing to assure the fans will provide many years of reliable performance.

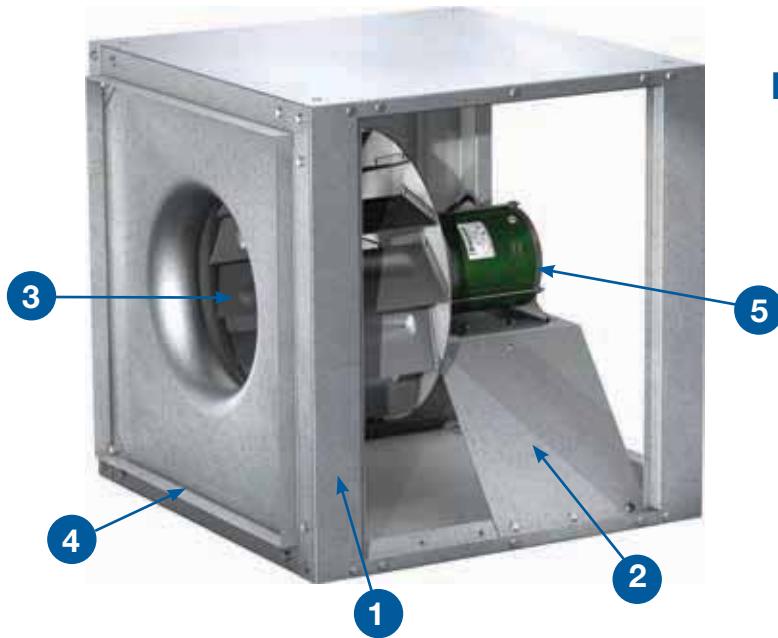
Over the years Greenheck has listened to your needs and input to remain the industry leader.

- Each fan is tested at the factory prior to shipping. The test includes vibration check, adjusting RPM and maximum amp draw.

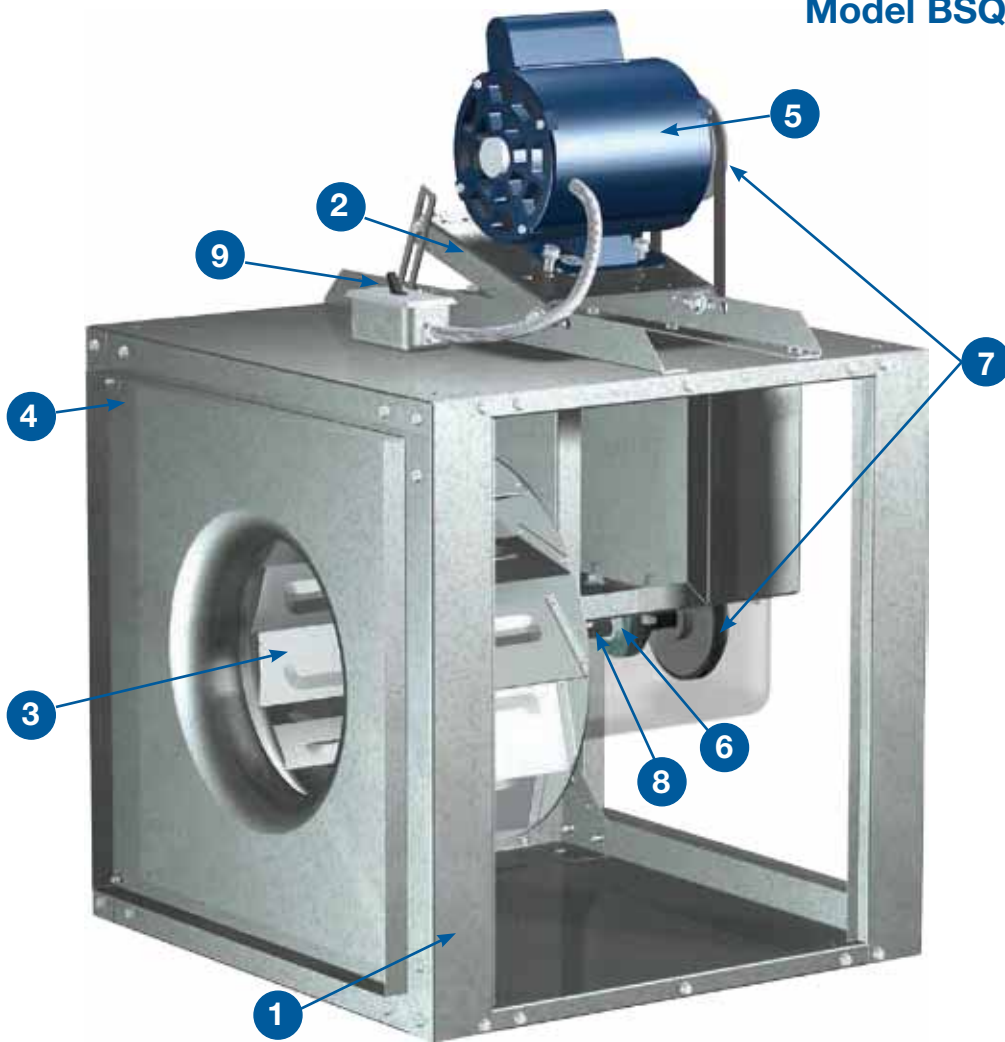


- Each fan displays a permanently stamped metal nameplate with complete model number, mark and unique serial number for future identification.
- Packaged-product is tested in accordance with ISTA (International Safe Transit Association) standards and procedures.

Turn to our inline fans to meet your requirements for applications in office buildings, schools and hospitals to name a few.



Model SQ Direct Drive



Model BSQ Belt Drive

1 Cabinet Construction

The fan housing is constructed of rigid structural members and formed galvanized steel panels. (Aluminum construction is optional in SQ sizes 60-160 and in BSQ sizes 70-300).

2 Drive Frame

Constructed from heavy-gauge steel.

3 Wheel

An aluminum, backward inclined, non-overloading centrifugal wheel is utilized to deliver maximum efficiency. Each wheel is statically and dynamically balanced.

4 Duct Collars

Inlet and discharge duct collars are provided for easy duct connection. The square design provides a larger discharge area than tubular centrifugal and vane axial fans; outlet velocities are reduced for quieter operation.

5 Motor

Permanently lubricated, sealed ball bearing motors are selected to provide years of trouble-free operation with minimal maintenance.

6 Bearings

100 percent factory tested bearings are designed specifically for air handling applications with a minimum L_{10} life in excess of 100,000 hours (L_{50} average life in excess of 500,000 hours).

7 Drive Assembly

Drives are sized for a minimum of 150 percent of driven horsepower. Machined cast iron pulleys are factory set to the required RPM and adjustable for final system balancing. Belts are static free and oil resistant. Belt adjustment is accomplished by loosening fasteners, sliding the motor plate and retightening fasteners.

8 Fan Shaft

Fan shafts are precisely sized, ground and polished so the first critical speed is at least 25 percent over the maximum operating speed. Close tolerances where the shaft makes contact with bearings result in longer bearing life.

9 Disconnect Switch

NEMA-1 disconnect switch is factory-mounted and wiring is provided from the motor as standard. All wiring and electrical components comply with the National Electric Codes and materials are UL Listed. Other NEMA enclosure disconnect switches are optional.

Access Panels *(not shown on images)*

The cabinet construction features two removable access panels permitting easy access to all interior components.



Vari-Green® Motor - Model SQ



Greenheck's electronically commutated (EC)

Vari-Green (VG) motor combines motor technology, controllability and energy-efficiency into one single low maintenance unit and is the industry's first fully controllable motor. When combined with Greenheck's SQ fans, all the CFM and static pressure ranges of a belt drive can be attained with the benefits of a direct drive.



VARI GREEN Motor

The Vari-Green motor is available in:

- 1/6 - 3/4 horsepower 115 volt only.
- 1 horsepower 115/208-230 volt.
- 2 horsepower 208-230 volt.

All motors are available in a 50/60 Hz power.

Benefits

Operates on AC power that's converted to DC—providing a more efficient motor operation as compared to an AC operation.

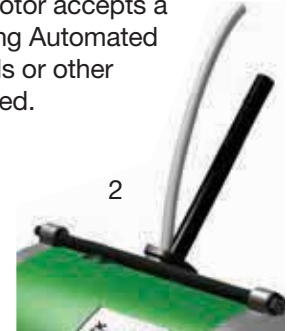
- The motor can attain up to 85% efficiency and reduce energy consumption.
- Watt savings of 30-70% depending on RPM. Note: As motor speed is turned down, efficiency stays high as compared to an AC motor that decreases dramatically.
- Operates cooler than a standard AC motor at lower RPMs. A cooler motor has longer motor life and reduces energy consumption.
- 80% usable RPM turndown vs. 30%. (chart at right)
- SQ fans with Vari-Green motors can provide all the CFM and static pressure ranges of a comparable belt drive.
- Maintenance costs are reduced as there are no belts or bearings to replace and no pulleys to adjust.
- Direct drive fans are often preferred where maintenance access is difficult.
- Provides a solution for demand controlled ventilation applications.

Vari-Green Advantages

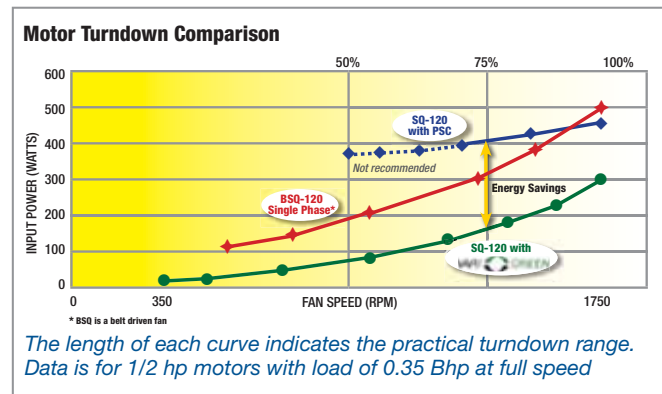
- Initial cost is similar to a belt drive
- Lower operating cost
- No maintenance, no belts, pulleys or bearings
- Easy RPM adjustment

Features

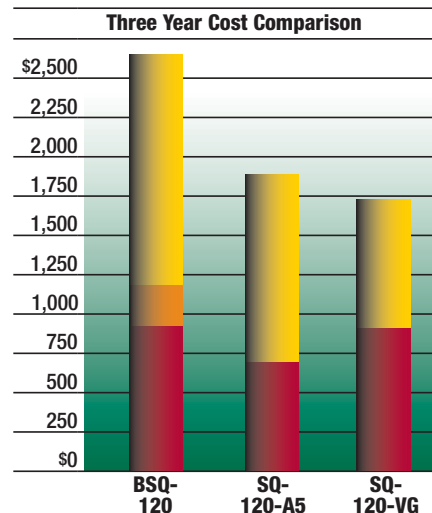
1. **Dial on Motor Control** - A potentiometer (dial on motor control) is mounted on the motor for easy speed adjustment for system balance. Simply turn the dial; there are no belts and pulleys to adjust.
2. **Control Wire Inputs** - the motor accepts a 0-10 VDC signal from Building Automated Systems, Vari-Green Controls or other controls to adjust motor speed.



Comparisons: Belt, Direct Drive with PSC and Direct Drive with Vari-Green



Constant Volume Life Cycle Analysis



Analysis is based on operating costs for a period of three years where the fans operate continuously at 1725 rpm, 24/7, with an energy rate of \$0.10/kWh. Maintenance on the SQ-120 is estimated at \$65/yr.

Note: Example is based on a relative cost. Use and installation variables may produce different results.

■ Initial Cost
 ■ Maintenance cost over three years
 ■ Operating cost over three years

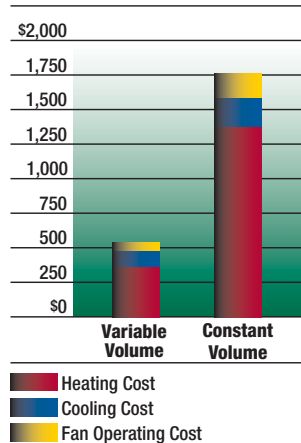
Demand Control Ventilation for Multistory Buildings



Applications requiring constant pressure or variable volume can utilize SQ fans with Vari-Green motors and Vari-Green controls.

Demand control ventilation systems reduce the amount of energy used by decreasing the speed of the fan when demand is low. This in turn lessens the amount of conditioned air exhausted and further reduces total operating costs associated with air conditioning and heating in multistoried buildings such as: hotels, multifamily complexes, institutional facilities, and high rise commercial buildings.

Variable Volume Operating Cost Analysis

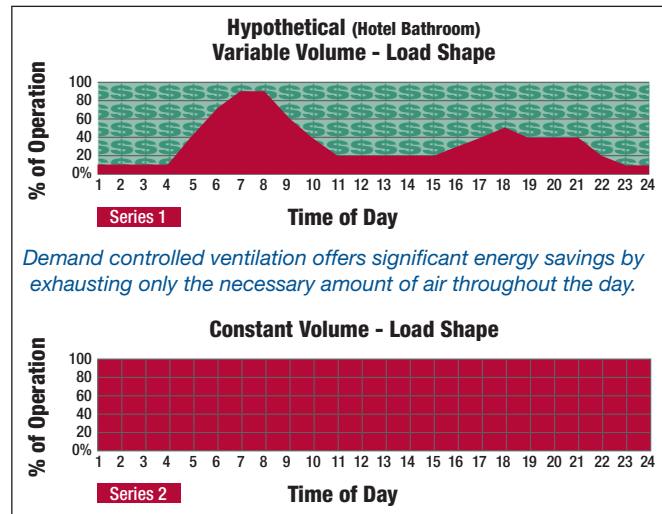


Example of potential savings based on a northeast city in the USA using Vari-Green components for variable volume.

The Vari-Green constant pressure control is pre-programmed and easy-to-install for applications that include: venting dryers, bathrooms, residential type kitchen space or industrial process exhaust.

Contact fans@greenheck.com for more information.

Daily Operating Comparison: Variable Volume and Constant Volume



Demand controlled ventilation offers significant energy savings by exhausting only the necessary amount of air throughout the day.

Note: A standard VFD compatible motor can also function within a variable volume system.

Vari-Green® Controls

Transformer - Provides 24V power from the existing line voltage at the fan to the Vari-Green motor and controls. Dual voltage primary (120/240V) transformer provided with the fan.

Remote Dial - Allows for remote, manual airflow adjustments. Wall plate with dial may be mounted in a standard 2x4 inch electrical junction box.

Two Speed Control with Integral Transformer Control allows motor rpm to be set at two independent speeds (high or low). Meets minimum airflow requirements with the ability to bump up to high speed in an emergency or meet maximum airflow requirements, or reset to low for energy conservation.

Constant Pressure Control - Indoor - Control Vari-Green motor via static (variable volume) or velocity (constant CFM) pressure on the inlet or outlet side of the fan. Optional, one or two, duct or room probes for use in:

- Multifamily structures - Apartments, condos, hotels; dryers, residential kitchens and bathrooms.
- Institutional facilities - Schools, prisons, multistory office buildings; bathrooms.

Constant Pressure Control - Outdoor

Control Vari-Green motor via static pressure on the inlet side of the fan. Includes one duct probe and transducer for use in:

- Multifamily structures - Apartments, condos, hotels; residential kitchen, dryer facilities and bathrooms.
- Institutional facilities - Schools, prisons, multistory.

Air Quality – VOC - Control a Vari-Green motor via changes in volatile organic compounds (VOC's). VOC's are gasses that are emitted from humans, building materials, perfumes, foods, and furniture off-gassing. Range is 0-2000 CO₂ ppm equivalent.

- Institutional facilities – Schools, court house, hospitals; bathrooms, waiting rooms, cafeteria.
- Commercial buildings – Office space, conference rooms, bathrooms, break room.

Air Quality – Temperature and Humidity - Control Vari-Green motor via changes in temperature, humidity, or both. Range is 32 to 120°F and 0 to 100% relative humidity.

- Multifamily structures – Apartments, condos, hotels; bathrooms, utility rooms.
- Commercial buildings – Office buildings; office space, conference rooms, utility rooms, bathrooms.

Options and Accessories



ALUMINUM CONSTRUCTION - Aluminum construction is available for all direct drive sizes 60-160 and belt drive sizes 70-300. Some drive frame components may still be of galvanized construction to maintain structural integrity.

INLET AND OUTLET GUARDS - Inlet and outlet guards provide protection for non-ducted applications. Guards are fabricated of welded wire on a galvanized steel frame. They are easily removed for maintenance and inspection.

BELT DRIVE MOTOR COVER AND BELT GUARD - For belt-driven fans, combination motor cover and belt guards constructed of galvanized steel are available for protection of motors, drives and personnel. Standard on units specified with UL.

DIRECT DRIVE MOTOR COVER - Formed, galvanized steel motor covers are available to isolate direct drive motors from the airstream. When motor covers are furnished, vents to the exterior of the fan are provided to ensure sufficient motor cooling.

INSULATED HOUSING - For noise reduction and condensation control, the interior of the fan housing can be lined with a 1-inch fiberglass duct liner. The optional motor cover can also be insulated.

The table depicts the radiated sound reduction that can be obtained in each octave band for the insulated housing and motor cover together.

Approximate Radiated Sound Attenuation (dB)								
Octave Band	1	2	3	4	5	6	7	8
Sizes 60 - 130	-2	-7	-4	-4	-6	-13	-13	-9
Sizes 140 - 420	-3	-2	-5	-4	-5	-5	-7	-8

BACKDRAFT DAMPERS - Gravity or motorized parallel blade dampers (model WD-330) are available for duct mounting. These dampers feature sturdy galvanized frames, aluminum blades with vinyl blade seals, and a balanced design for minimal resistance to airflow.



CONTROL DAMPERS - Square, opposed blade volume control dampers (model VCD) are available for duct mounting. These dampers feature sturdy galvanized frames, and steel blades with optional blade and jamb seals. A balanced design results in minimal resistance to airflow.

INLET VANE DAMPERS - Variable inlet vane dampers (model IVDE) are available for models SQ and BSQ sizes 140-420 and are factory-assembled to the fan. They can be specified for either manual or automatic operation (controls furnished by others). These dampers are constructed of heavy-gauge steel and feature uniform blade movement for positive control. Companion inlet rings for round duct connections are also available.

SPEED CONTROLLERS - Available for use with shaded pole and permanent split capacitor (PSC) motors on model SQ fans. They provide an economical means of system balancing with direct drive fans.



MOTOR STARTERS - The fundamental function of a motor starter is to protect the motor from damage that can occur from overheating. With a Greenheck motor starter, you will be provided with the best motor protection available.



Specific model components may include; SmartStart™ technology, physical interface, overload protection, disconnect, magnetic contactor, NEMA-1 or NEMA-3R steel enclosures and pre-engineered easy system integration. For complete information on specific Greenheck Motor Starter models refer to greenheck.com, Products, Motor Starter page.

WIRING PIGTAIL - Allows direct hook-up to the power supply eliminating field wiring at the fan.

COATINGS - Wide variety of coatings and colors are available.

Decorative coatings are available in sixteen standard colors.

Protective coatings are available in a choice of five electrostatic applied powders providing an available selection for most environments.

All Greenheck coatings and resistance charts can be found in our Performance Coatings for Commercial & Industrial Fans brochure.



The filter box is designed to provide a compact and convenient clean air solution. Factory-assembled as a single unit, this fan eliminates the costly process of designing, fabricating and installing special remote filter box assemblies. Both the fan and filter section feature removable access panels on both sides to remove and replace filters, making fan maintenance simple and fast.



Model Selection Procedure

1. Calculate system pressure drop and cfm requirements (not including filters).
2. Make a preliminary model size selection.
3. Calculate a filter pressure drop (P) for the preliminary model size selected in step 2 using the equation: $P = F \times \left(\frac{\text{cfm}}{10,000}\right)^2$
 - To determine the filter factor (F) refer to chart below.
4. Add the filter pressure drop (P) to the system pressure drop and make a revised model size selection.

Model	Fan Size	Filter Box Weight	Filter Size	Filter Quantity	Filter Factor (F)			
					1 inch (25)		2 inch (51)	
					Aluminum	Paper Filters (MERV 7)	Aluminum	Paper Filters (MERV 8)
Model SQ	60 - 75	40 (18)	10 x 12 (254 x 305)	1	186	318.06	251.1	303.18
	80 - 95	74 (34)	14 x 25 (356 x 635)	1	21.8	37.28	29.43	35.53
	100	88 (40)	16 x 20 (406 x 508)	2	8.72	14.91	11.77	14.21
	120	114 (52)	16 x 25 (406 x 635)	2	5.58	9.54	7.53	9.10
	130	120 (54)	20 x 20 (508 x 508)	2	5.58	9.54	7.53	9.10
	140	174 (79)	20 x 25 (508 x 635)	2	3.57	6.11	4.82	5.82
	160	246 (112)	20 x 20 (508 x 508)	4	2.09	3.57	2.82	3.41
Model BSQ	70 - 80 - 90	117 (53)	14 x 25 (356 x 635)	1	21.8	37.28	29.43	35.53
	100	120 (54)	16 x 20 (406 x 508)	2	8.72	14.91	11.77	14.21
	120	144 (79)	16 x 25 (406 x 635)	2	5.58	9.54	7.53	9.10
	130 - 130HP	140 (64)	20 x 20 (508 x 508)	2	5.58	9.54	7.53	9.10
	140 - 140HP	181 (82)	20 x 25 (508 x 635)	2	3.57	6.11	4.82	5.82
	160 - 160HP	294 (133)	20 x 20 (508 x 508)	4	2.09	3.57	2.82	3.41
	180 - 180HP	344 (156)	20 x 25 (508 x 635)	4	1.34	2.29	1.81	2.18
	200 - 200HP	441 (200)	12 x 25 (305 x 635)	3	0.77	1.32	1.04	1.26
			16 x 25 (406 x 635)	3				
	240 - 240HP	573 (260)	20 x 25 (508 x 635)	4	0.41	0.70	0.55	0.67
			16 x 25 (406 x 635)	4				
	300 - 300HP	759 (344)	20 x 25 (508 x 635)	8	0.33	0.56	0.45	0.54
	360 - 360HP	957 (434)	16 x 25 (406 x 635)	10	0.15	0.26	0.20	0.25
			20 x 25 (508 x 635)	5				
420	1185 (538)	16 x 25 (406 x 635)	5	0.13	0.22	0.18	0.21	
		20 x 25 (508 x 635)	10					

Note: 24-inch side clearance is recommended for accessing and removing filters. All dimensions in inches (millimeters) and weight in pounds (kilograms).

The side discharge option helps to reduce system effect. It will increase performance and reduce installation labor. The most notable is reducing system effects. Note: The figure 1 example shows the air being discharged into the corner. It will take several duct lengths before the airflow becomes laminar or smooth again after making the turn.

In figure 2, the fan is placed in the corner using a side discharge. In this configuration the air flow pattern at discharge is smooth and supports a more predictable system. Remember the duct length on the discharge side, should be approximately two to three wheel diameters to achieve catalog performance.

Discharge Configuration

Fan performance will change with different discharge positions. Catalog data is based on an inline discharge. Right side discharge will give you 108% of cataloged performance and left side will give you 109% of cataloged performance. Use figure 3 to locate the orientation to fit your application.

Figures 4 and 5 on page 11, illustrate the proper side discharge definitions. Refer to Greenheck's CAPS (Computer Aided Product Selection) program or consult factory for performance modifications.

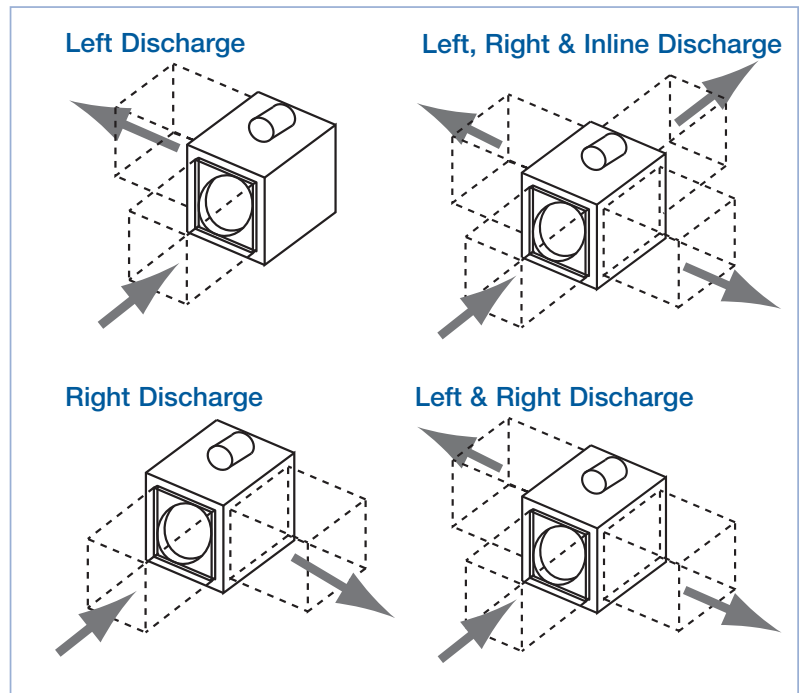
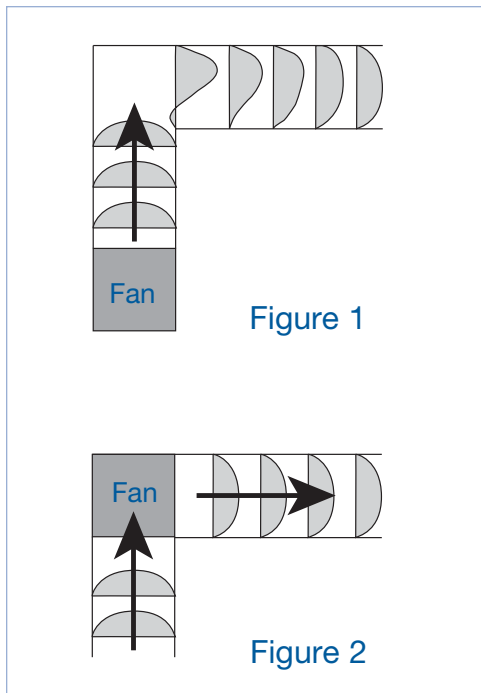


Figure 3

SQ Side Discharge

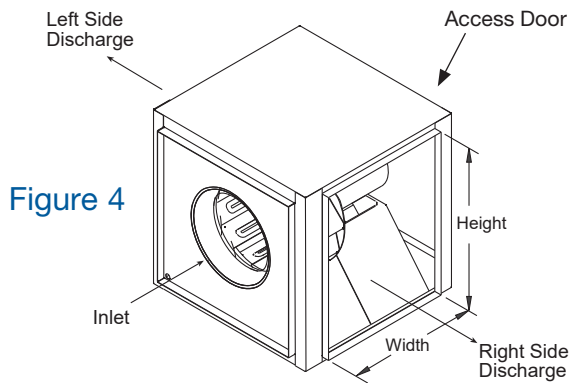


Figure 4

BSQ Side Discharge

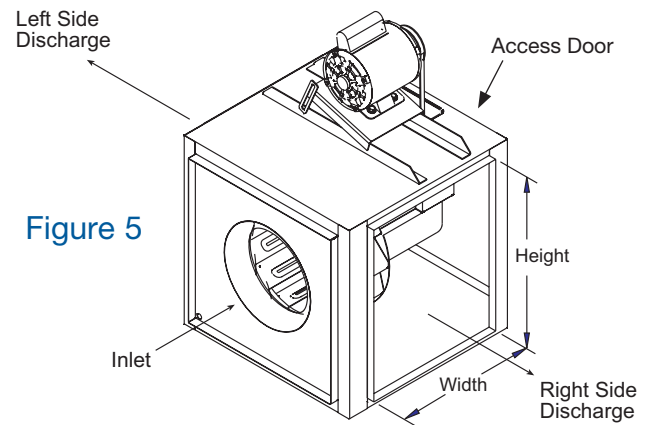


Figure 5

SQ Side Discharge Duct Openings		
Unit Size	Width	Height
60-75	9 ⁷ / ₈ (251)	8 ⁷ / ₈ (225)
80-95	12 ⁷ / ₈ (327)	11 ⁷ / ₈ (302)
100	13 ⁷ / ₈ (352)	13 ⁷ / ₈ (352)
120	15 ⁷ / ₈ (403)	15 ⁷ / ₈ (403)
130	17 ⁷ / ₈ (454)	17 ⁷ / ₈ (454)
140	19 ⁷ / ₈ (505)	19 ⁷ / ₈ (505)
160	22 ⁷ / ₈ (581)	22 ⁷ / ₈ (581)

All dimensions in inches (millimeters).

BSQ Side Discharge Duct Openings		
Unit Size	Width	Height
70-80-90	11 ⁷ / ₈ (302)	11 ⁷ / ₈ (302)
100	13 ⁷ / ₈ (352)	13 ⁷ / ₈ (352)
120	15 ⁷ / ₈ (403)	15 ⁷ / ₈ (403)
130-130HP	17 ⁷ / ₈ (454)	17 ⁷ / ₈ (454)
140-140HP	19 ⁷ / ₈ (505)	19 ⁷ / ₈ (505)
160-160HP	22 ⁷ / ₈ (581)	22 ⁷ / ₈ (581)
180-180HP	23 ⁷ / ₈ (606)	23 ⁷ / ₈ (606)
200-200HP	27 ⁷ / ₈ (708)	27 ⁷ / ₈ (708)
240-240HP	28 ⁷ / ₈ (733)	34 ⁷ / ₈ (886)
300-300HP	31 ⁷ / ₈ (810)	41 ⁷ / ₈ (1064)
360-360HP	32 ⁷ / ₈ (835)	48 (1219)
420	34 ⁷ / ₈ (886)	53 ³ / ₄ (1114)

All dimensions in inches (millimeters).

Horizontal and Vertical Mounting Options

All SQ and BSQ fan models can be mounted horizontally, vertically or at an angle. For ease of installation, knockouts are provided at each location where mounting brackets are shown in figures 6, 7 and 8. Optional brackets are universally adjustable to mount in any of these locations.

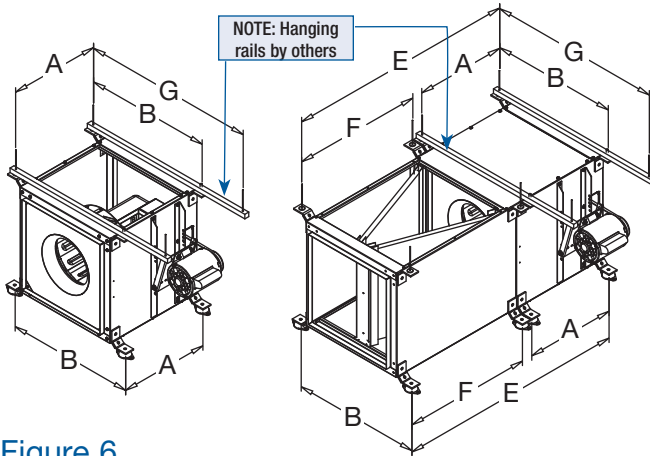


Figure 6
Horizontal Hanging or Base Mount

With either a hanging or base mount the motor may be located on either side. The base mount allows top access panels only.

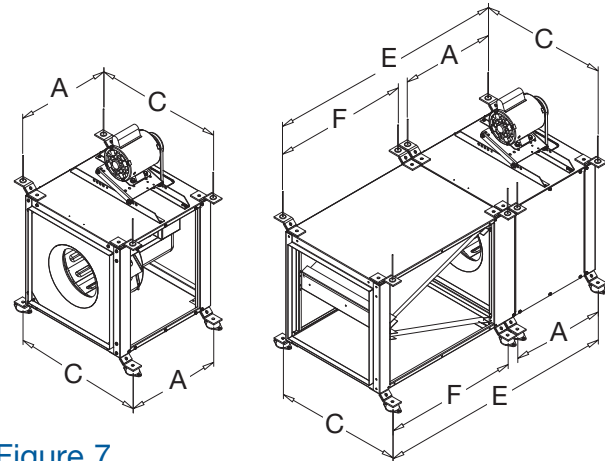


Figure 7
Horizontal Hanging or Base Mount

With a hanging mount, the motor may be located on either top or bottom. The base mount allows top motor location only. Both options provide access panels on two sides.

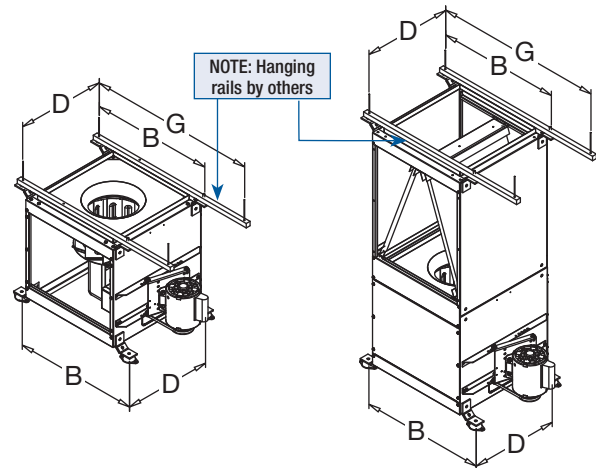
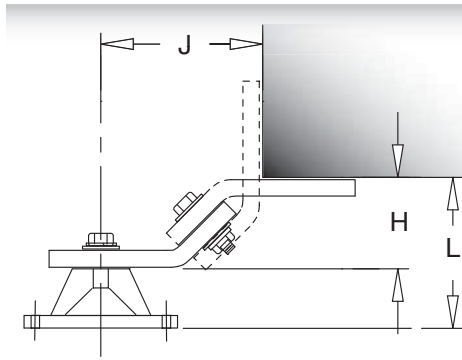


Figure 8
Vertical Hanging or Base Mount

Mounting brackets are turned 90 degrees for vertical mounting. Access panels are located on the two sides adjacent to the motor.

Model	A	B	C	D	E	F	G
SQ 60-75	10 ⁵ / ₈ (270)	17 (432)	15 ³ / ₄ (400)	8 ⁷ / ₈ (225)	19 ³ / ₄ (502)	7 (178)	Hanging rails not included. Supplied by others.
SQ 80-95	13 ¹ / ₄ (337)	20 (508)	18 ³ / ₄ (476)	11 ⁷ / ₈ (302)	43 (1092)	27 ³ / ₈ (695)	
BSQ 70-90	18 ⁵ / ₈ (473)	20 ¹ / ₈ (511)	18 ³ / ₄ (476)	11 ⁷ / ₈ (302)	48 ⁵ / ₁₆ (1227)	27 ³ / ₈ (695)	
SQ-BSQ 100	18 ⁵ / ₈ (473)	22 ¹ / ₈ (562)	20 ³ / ₄ (527)	13 ³ / ₈ (352)	44 ⁷ / ₈ (1140)	24 (610)	
SQ-BSQ 120	18 ⁵ / ₈ (473)	24 (610)	22 ³ / ₄ (578)	16 (406)	49 ³ / ₈ (1254)	28 ¹ / ₈ (714)	
SQ-BSQ 130	18 ⁵ / ₈ (473)	26 ¹ / ₈ (664)	24 ³ / ₄ (629)	17 ⁷ / ₈ (454)	44 (1118)	23 (584)	
SQ-BSQ 140	19 ⁵ / ₈ (498)	28 ¹ / ₈ (714)	26 ³ / ₄ (679)	19 ⁷ / ₈ (505)	50 ¹ / ₁₆ (1272)	28 (711)	
SQ-BSQ 160	23 ¹ / ₂ (597)	31 (787)	29 ³ / ₄ (756)	22 ⁷ / ₈ (581)	49 ³ / ₈ (1260)	23 ³ / ₈ (600)	Hanging rails not included. Supplied by others.
BSQ 180	25 ¹ / ₂ (648)	33 ¹ / ₂ (851)	29 ⁹ / ₁₆ (751)	22 ³ / ₄ (578)	52 ⁵ / ₁₆ (1335)	24 ¹ / ₂ (622)	
BSQ 200	29 ¹ / ₈ (740)	37 (940)	33 ³ / ₄ (857)	26 ³ / ₄ (679)	64 ¹ / ₁₆ (1630)	32 ¹ / ₄ (819)	
BSQ 240	31 ⁵ / ₈ (803)	44 ¹ / ₄ (1124)	40 ³ / ₄ (1035)	33 ³ / ₈ (860)	66 ¹ / ₂ (1689)	32 ¹ / ₈ (816)	
BSQ 300	35 (889)	51 (1295)	47 ³ / ₄ (1213)	40 ⁷ / ₈ (1038)	69 ¹ / ₈ (1756)	31 ³ / ₈ (797)	
BSQ 360	38 ³ / ₄ (974)	57 ¹ / ₄ (1454)	53 ¹ / ₂ (1359)	46 ³ / ₄ (1187)	76 (1930)	34 ¹¹ / ₁₆ (881)	
BSQ 420	47 ¹ / ₈ (1197)	63 (1600)	59 ⁷ / ₈ (1521)	59 ⁷ / ₈ (1521)	90 ¹ / ₂ (2299)	40 ¹ / ₂ (1029)	

All dimensions in inches (millimeters).

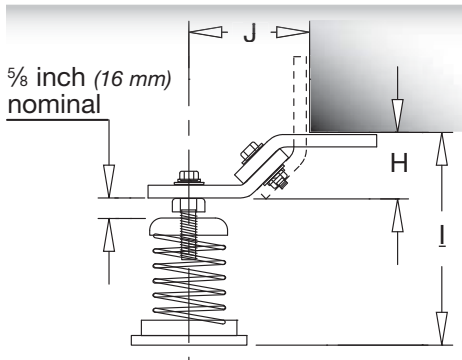


Standing Neoprene Isolator



Complete isolation kits are available with either neoprene or spring isolators and are sized to match the weight of the specified fan size. The base isolator support brackets are designed to permit mounting of the fan with the motor located on top or either side. The hanging isolator support brackets are designed to permit mounting of the fan with the motor located on top, bottom or side.

Note: Hanging rods to be supplied by others.

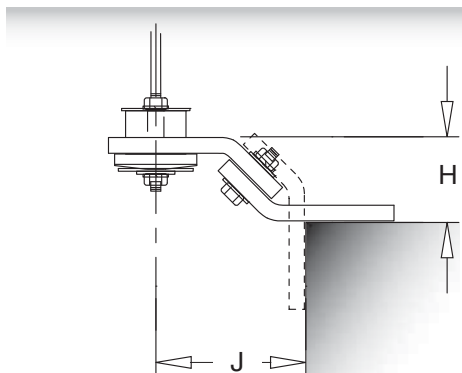


Standing Spring Isolator

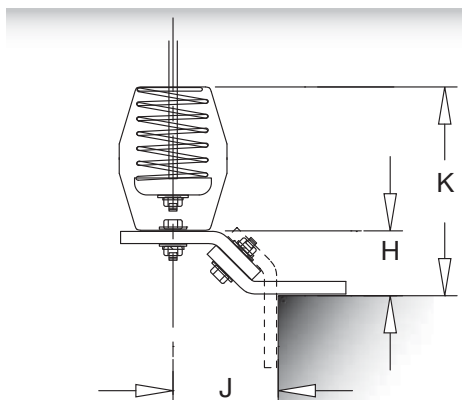


Model	H	I	J	K	L
SQ 60-75					
SQ 80-95					
BSQ 70-90					
SQ-BSQ 100	1 3/8 (35)	5 1/2 (140)	2 (51)	6 3/4 (171)	2 5/16 (59)
SQ-BSQ 120					
SQ-BSQ 130					
SQ-BSQ 140					
SQ-BSQ 160					
BSQ 180					
BSQ 200					
BSQ 240	1 3/8 (35)	5 1/2 (140)	2 (51)	6 3/4 (171)	2 5/8 (67)
BSQ 300					
BSQ 360					
BSQ 420					

All dimensions in inches (millimeters).



Hanging Neoprene Isolator



Hanging Spring Isolator



Typical Installation



Models SQ and BSQ ducted inline fans are designed for the exhaust, supply or recirculation of air in a building. Typical installation requires ductwork on the inlet and outlet side of the fan. A minimum of three duct diameters is required on the inlet and outlet of the fan to minimize system effect losses. See the diagram below for a typical installation.

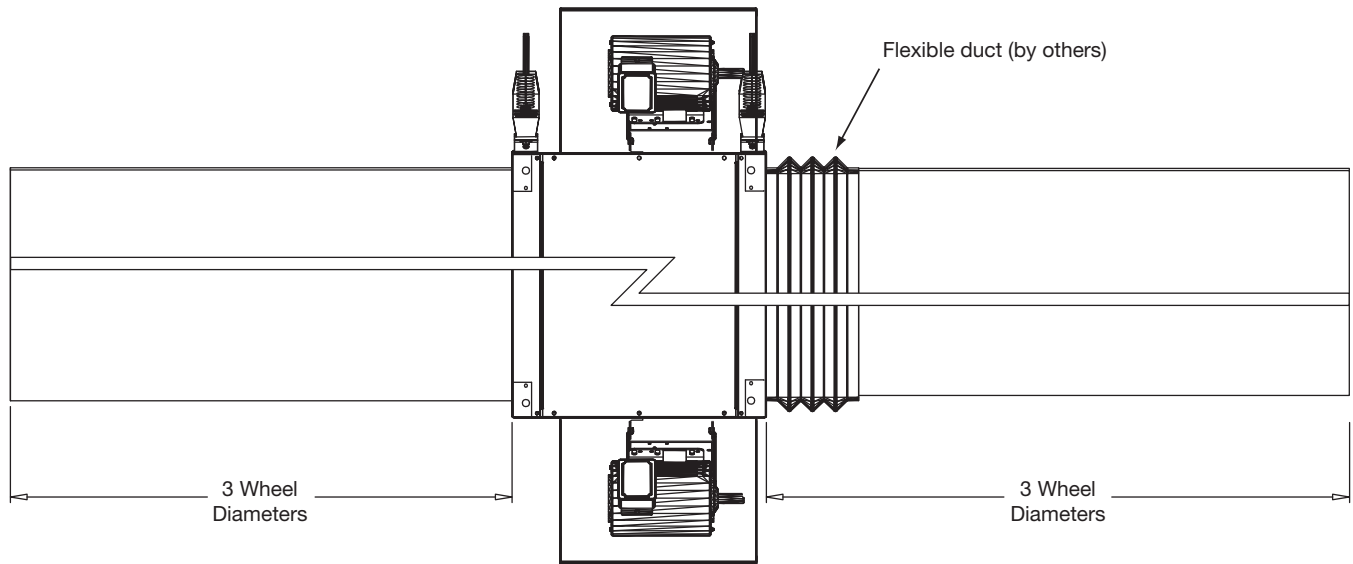
Installations can include flexible duct connections (by others) on either the inlet or outlet side of the fan or

both. The motor is rigidly mounted and can be oriented in any direction (top, bottom, side).

The model BSQ ducted inline fan must be installed with the motor accessible for maintenance and inspection.

External isolators are recommended, hanging (shown below) or base mounted.

Installation must meet all local governing codes and the NEC.



Model Number Code

The model number system is designed to completely identify the fan. The correct code letters must be specified to designate belt or direct drive. The remainder of the model number is determined by the size and performance selected from the following pages.

BSQ - 120 HP - VG/5/A

MODEL CONFIGURATION

- BSQ - Belt Drive Inline Exhaust
- SQ - Direct Drive Inline Exhaust

FAN SIZE

60 through 420

PRESSURE LEVEL (Belt Drive Only)

HP - High Pressure Wheel

VG = Vari-Green®
(Direct Drive only)

MOTOR HP (Belt Drive only)

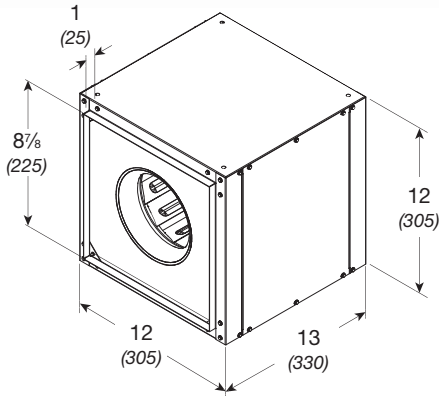
- | | | |
|---------|---------|----------|
| 6 = 1/6 | 7 = 3/4 | 30 = 3 |
| 4 = 1/4 | 10 = 1 | 50 = 5 |
| 3 = 1/3 | 15 = 1½ | 75 = 7½ |
| 5 = 1/2 | 20 = 2 | 100 = 10 |

MOTOR RPM (Direct Drive only)

- | | |
|----------|----------|
| A = 1725 | D = 1550 |
| B = 1140 | E = 1050 |
| C = 860 | G = 1300 |

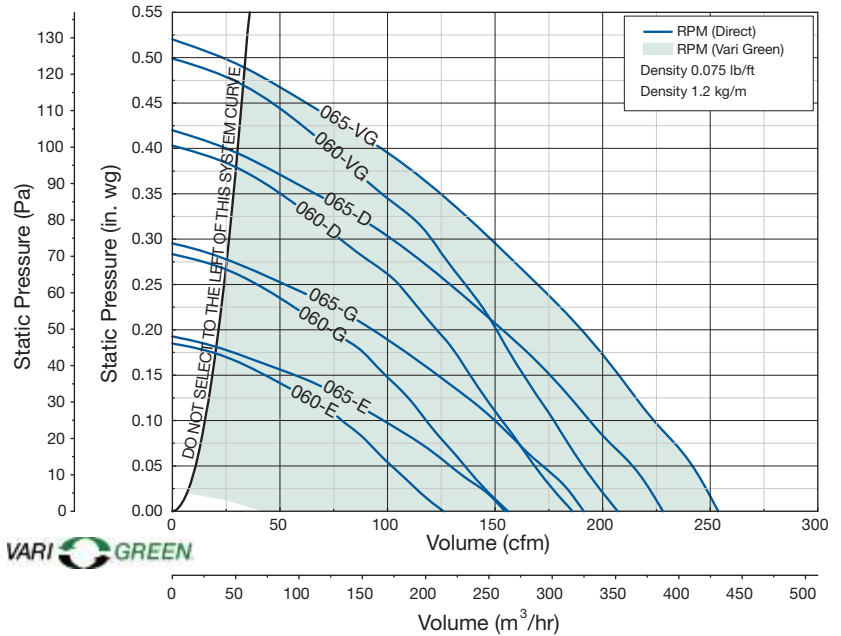
International
(See CAPS for performance)
K = 950 RPM J = 1475 RPM

SQ 60-65 - Direct Drive



Damper size = 9 x 9 (229 x 229)
 Unit weight** = 26 (12)
 Housing thickness = 18 ga
 Outlet velocity = 1.828 x cfm

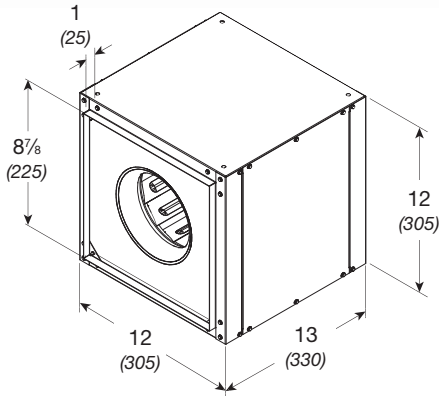
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP		Fan RPM		CFM / Static Pressure in Inches wg											
Direct				0.000	0.050	0.100	0.125	0.150	0.200	0.250	0.300	0.350	0.375		
60															
VARI GREEN	VG-1/6	E-1/140	1050	CFM	126	102	79	63	42						
				BHP	0.01	0.01	0.01	0.01	0.01						
				Sones	1.7	1.7	1.7	1.7	1.8						
	G-1/80	1300	CFM	156	136	118	110	99	73	37					
			BHP	0.01	0.01	0.01	0.01	0.01	0.01	0.01					
			Sones	2.9	2.7	2.7	2.6	2.6	2.5	2.5					
	D-1/40	1550	CFM	186	168	153	146	138	123	105	78	48	32		
			BHP	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
			Sones	4.3	4.1	3.9	3.9	3.9	3.9	4.0	4.0	4.1	4.1		
		1725	CFM	207	191	177	170	163	150	136	120	98	85		
			BHP	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	
			Sones	5.4	5.2	5.1	5.0	5.0	5.1	5.1	5.3	5.5	5.6		
65															
VARI GREEN	VG-1/6	E-1/100	1050	CFM	154	129	98	79	57						
				BHP	0.01	0.01	0.01	0.01	0.01						
				Sones	2.2	2.1	2.0	2.0	1.9						
	G-1/50	1300	CFM	191	172	150	137	123	92	52					
			BHP	0.01	0.01	0.02	0.02	0.02	0.02	0.02					
			Sones	3.2	3.1	3.0	2.9	2.9	2.9	2.8					
	D-1/30	1550	CFM	228	213	194	185	175	153	129	101	66	46		
			BHP	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02		
			Sones	4.9	4.8	4.5	4.4	4.3	4.1	4.0	3.9	3.7	3.6		
		1725	CFM	254	242	224	216	207	190	170	148	124	111		
			BHP	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	
			Sones	6.4	6.1	5.8	5.7	5.5	5.3	5.2	5.0	4.8	4.7		

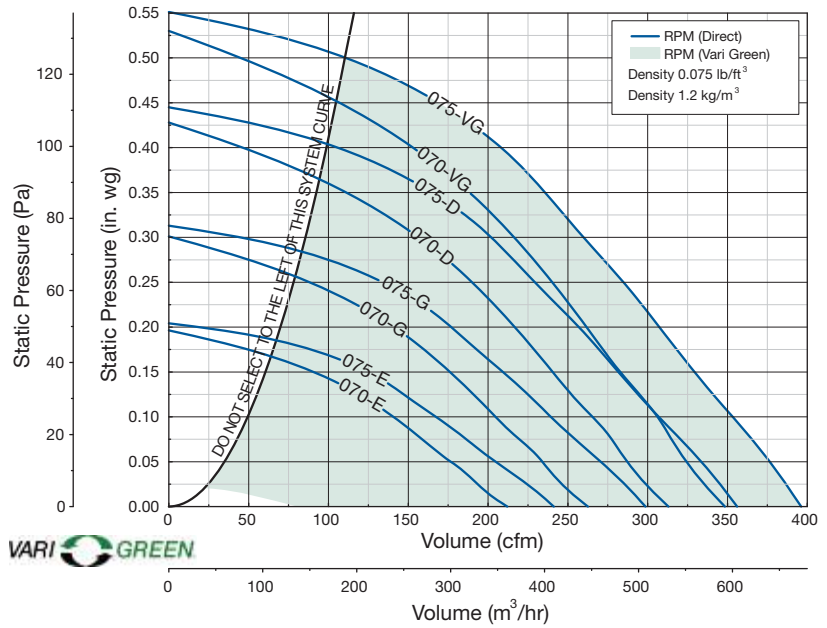
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 70-75 - Direct Drive



Damper size = 9 x 9 (229 x 229)
 Unit weight** = 26 (12)
 Housing thickness = 18 ga
 Outlet velocity = 1.828 x cfm

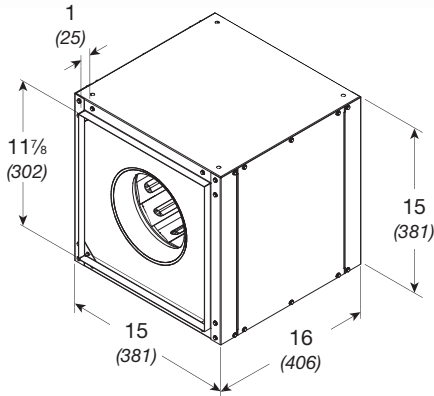
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM		CFM / Static Pressure in Inches wg										
			0.000	0.100	0.125	0.150	0.200	0.250	0.300	0.350	0.375	0.400	
70													
VARI GREEN VG-1/6	E-1/100	1050	CFM	212	141	119	87						
			BHP	0.01	0.01	0.01	0.01						
			Sones	2.7	1.7	1.5	1.5						
	G-1/50	1300	CFM	263	205	191	176	140	77				
			BHP	0.02	0.02	0.0	0.02	0.02	0.02				
			Sones	4.1	3.4	3.3	3.1	2.9	2.5				
	D-1/30	1550	CFM	313	265	252	240	216	190	155	99	67	
			BHP	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	
			Sones	5.6	5.2	5.1	5.1	4.9	4.7	4.5	4.2	4.0	
		1725	CFM	348	306	295	283	262	240	216	187	171	148
			BHP	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
			Sones	6.8	6.7	6.6	6.6	6.5	6.4	6.2	6.0	5.9	5.8
75													
VARI GREEN VG-1/6	E-1/100	1050	CFM	241	167	147	124						
			BHP	0.01	0.01	0.01	0.01						
			Sones	3.6	2.9	2.8	2.6						
	G-1/50	1300	CFM	299	239	225	209	176	133				
			BHP	0.02	0.02	0.020	0.02	0.02	0.02				
			Sones	4.1	3.7	3.7	3.7	3.6	3.5				
	D-1/30	1550	CFM	356	307	294	282	257	229	202	165	137	99
			BHP	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
			Sones	6.1	5.5	5.4	5.3	5.1	4.9	4.9	4.8	4.8	4.8
		1725	CFM	396	353	341	330	307	285	260	235.0	223	206
			BHP	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			Sones	8.0	7.2	7.0	6.8	6.5	6.2	6.1	6.0	6.0	6.0

Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

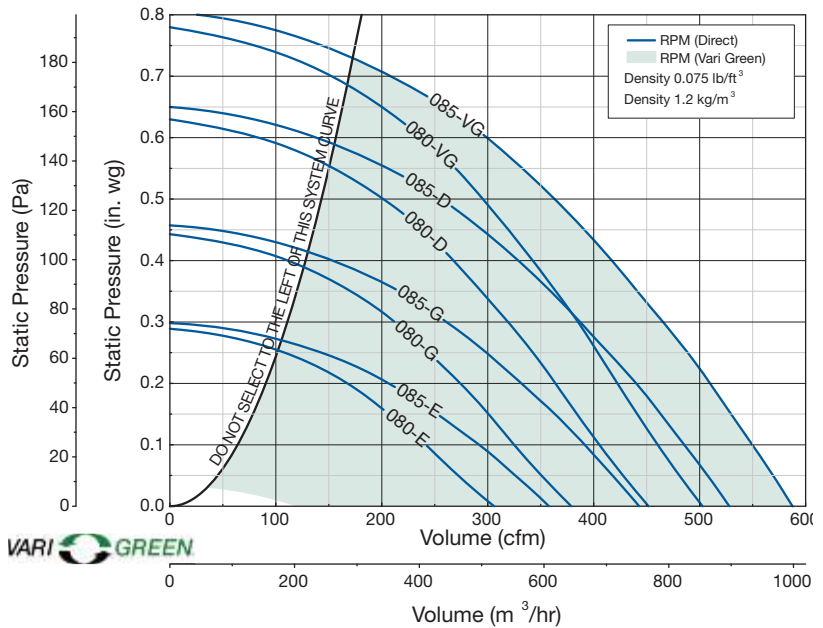
SQ 80-85 - Direct Drive



Damper size = 12 x 12 (305 x 305)
 Unit weight** = 41 (19)
 Housing thickness = 18 ga
 Outlet velocity = 1.021 x cfm

Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).

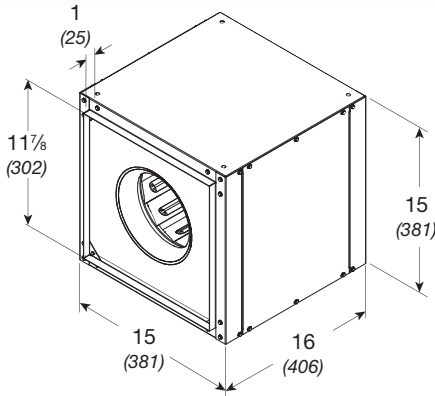
**Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM	CFM / Static Pressure in Inches wg											
		0.000	0.100	0.125	0.200	0.250	0.300	0.375	0.400	0.450	0.500		
80													
VG-1/6 or 1/4	E-1/40	1050	CFM	306	241	225	167	105					
			BHP	0.01	0.01	0.02	0.02	0.02					
			Sones	3.8	3.7	3.6	3.8	4.1					
	G-1/20	1300	CFM	379	325	313	274	244	211	140			
			BHP	0.02	0.03	0.03	0.03	0.03	0.03	0.03			
			Sones	5.4	5.4	5.4	5.4	5.4	5.4	5.5			
	D-1/12	1550	CFM	452	405	395	364	343	319	280	266	238	201
			BHP	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06
			Sones	7.3	7.3	7.3	7.3	7.2	7.3	7.3	7.4	7.5	7.6
		1725	CFM	503	461	451	423	404	385	354	342	319	294
			BHP	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.07	0.08	0.08
			Sones	8.4	8.5	8.6	8.5	8.6	8.6	8.6	8.6	8.7	8.7
85													
VG-1/6 or 1/4	E-1/40	1050	CFM	358	292	272	206	142					
			BHP	0.01	0.02	0.02	0.02	0.02					
			Sones	3.8	3.7	3.6	3.8	4.0					
	G-1/20	1300	CFM	443	391	378	332	299	261	186			
			BHP	0.02	0.03	0.03	0.03	0.03	0.03	0.03			
			Sones	5.4	5.4	5.4	5.4	5.4	5.4	5.5			
	D-1/12	1550	CFM	528	485	474	440	414	387	344	328	294	254
			BHP	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06
			Sones	7.3	7.3	7.3	7.3	7.3	7.2	7.3	7.3	7.4	7.5
		1725	CFM	588	550	540	510	488	465	429	416	391	362
			BHP	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.08
			Sones	8.7	8.7	8.6	8.6	8.6	8.6	8.7	8.7	8.7	8.8

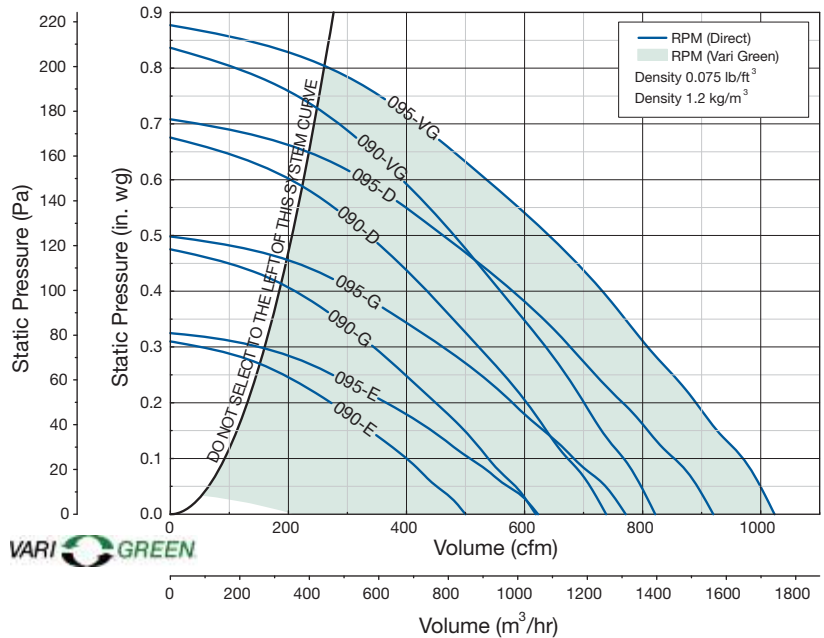
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 90-95 - Direct Drive



Damper size = 12 x 12 (305 x 305)
 Unit weight** = 41 (19)
 Housing thickness = 18 ga
 Outlet velocity = 1.021 x cfm

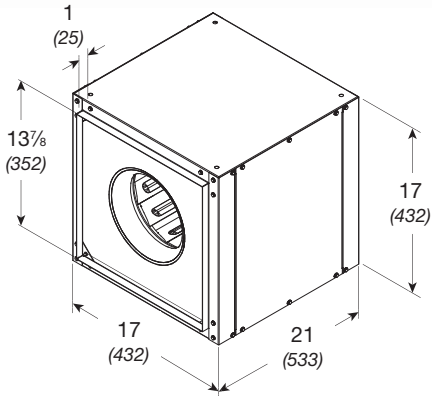
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP		Fan RPM		CFM / Static Pressure in Inches wg												
Direct				0.000	0.125	0.200	0.250	0.300	0.375	0.400	0.500	0.600	0.625			
90																
VARI GREEN	VG-1/6 or 1/4	E-1/50	1050	CFM	500	370	271	188								
				BHP	0.02	0.02	0.02	0.02								
				Sones	4.0	3.9	4.0	4.1								
	G-1/25	1300	CFM	619	519	449	398	343	245	208						
			BHP	0.03	0.04	0.04	0.04	0.04	0.04	0.04						
			Sones	5.4	5.4	5.4	5.5	5.5	5.6	5.6						
	D-1/10	1550	CFM	738	655	603	565	522	457	435	334					
			BHP	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07					
			Sones	7.6	7.5	7.5	7.4	7.4	7.4	7.4	7.4					
		1725	CFM	821	748	701	669	635	579	559	481	392	366			
			BHP	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09			
			Sones	8.8	8.8	8.8	8.7	8.7	8.8	8.8	8.8	8.8	8.9			
95																
VARI GREEN	VG-1/6 or 1/4	E-1/30	1050	CFM	623	475	365	275								
				BHP	0.03	0.03	0.03	0.03								
				Sones	4.9	4.5	4.4	4.5								
	G-1/15	1300	CFM	771	660	580	523	461	352	311						
			BHP	0.05	0.06	0.06	0.06	0.06	0.06	0.06						
			Sones	7.6	6.7	6.5	6.4	6.4	6.4	6.4						
	D-1/8	1550	CFM	920	830	766	720	678	604	579	462	325	276			
			BHP	0.09	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.09	0.09		
			Sones	9.6	9.3	8.9	8.7	8.4	8.1	8.0	7.6	7.2	7.1			
		1725	CFM	1024	948	890	850	809	751	729	641	535	507			
			BHP	0.12	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14			
			Sones	11.3	11.0	10.8	10.6	10.4	10.1	9.9	9.8	9.3	9.2			

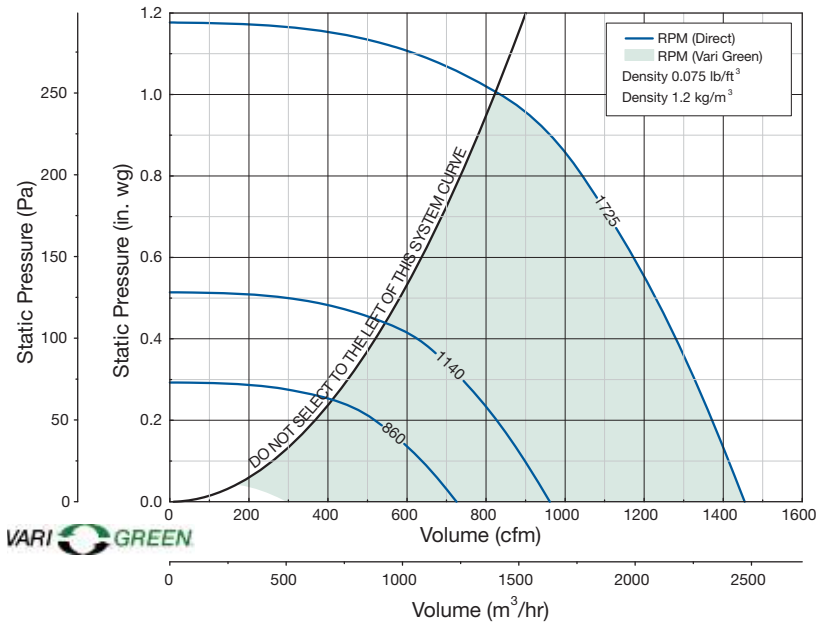
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 100 - Direct Drive



Damper size = 14 x 14 (356 x 356)
 Unit weight** = 56 (25)
 Housing thickness = 18 ga
 Outlet velocity = 0.748 x cfm

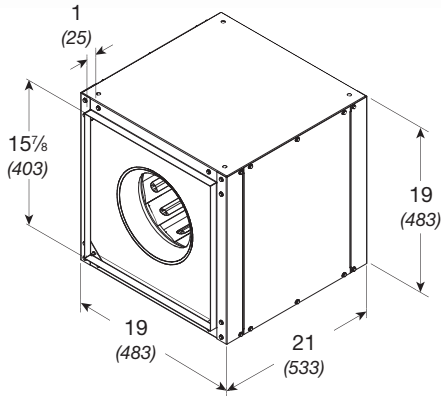
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM	CFM / Static Pressure in Inches wg																		
		0.000	0.100	0.125	0.250	0.300	0.375	0.500	0.625	0.750	1.000									
100																				
VG-1/4 	C-1/8	860	CFM	725	638	611														
			BHP	0.03	0.03	0.03														
			Sones	4.7	3.8	3.7														
	B-1/6	1140	CFM	961	898	881	786	739	657											
			BHP	0.06	0.07	0.07	0.07	0.07	0.07											
			Sones	7.4	6.6	6.5	6.1	5.9	5.6											
A-1/4	1725	CFM	1455	1413	1403	1350	1327	1292	1227	1156	1078	831								
		BHP	0.22	0.23	0.23	0.23	0.24	0.24	0.24	0.25	0.25	0.22								
		Sones	13.2	12.6	12.5	11.9	11.7	11.5	11.1	10.7	10.4	9.6								

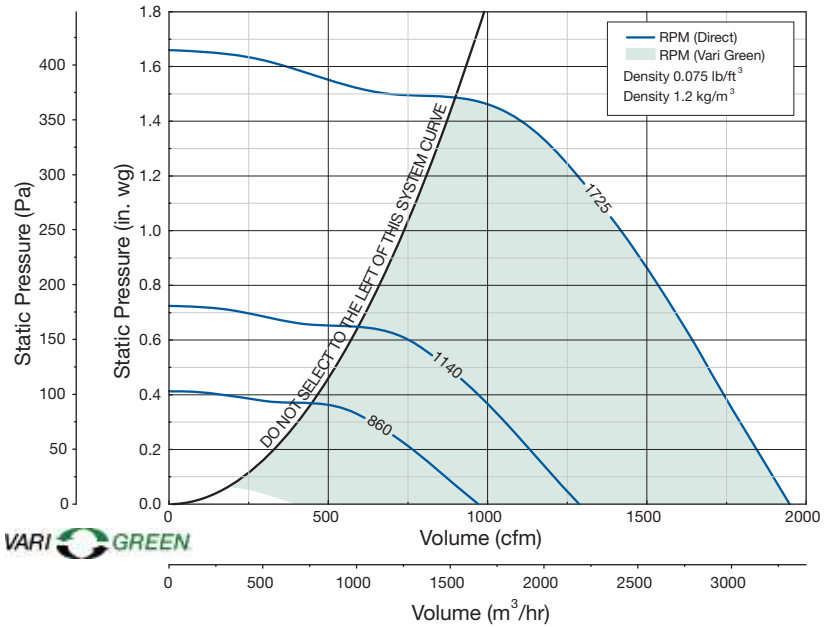
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 120 - Direct Drive



Damper size = 16 x 16 (406 x 406)
 Unit weight** = 67 (30)
 Housing thickness = 18 ga
 Outlet velocity = 0.571 x cfm

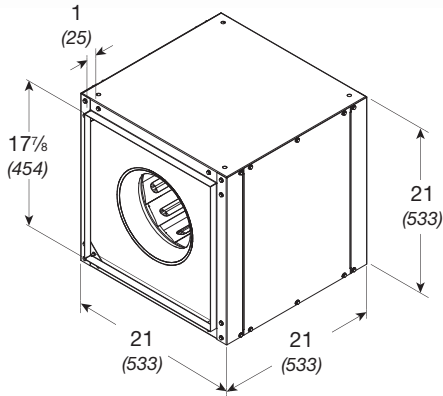
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM		CFM / Static Pressure in Inches wg										
			0.000	0.125	0.250	0.375	0.500	0.625	0.750	1.000	1.250	1.375	
120													
VG-1/2 VARI GREEN	C-1/8	860	CFM	971	843	704							
			BHP	0.05	0.06	0.06							
			Sones	4.4	4.1	3.3							
	B-1/6	1140	CFM	1287	1190	1095	992	873	693				
			BHP	0.12	0.12	0.13	0.14	0.14	0.13				
			Sones	7.4	7.2	7.0	6.3	5.9	5.8				
	A-1/2	1725	CFM	1948	1884	1819	1754	1692	1629	1563	1417	1240	1128
			BHP	0.41	0.42	0.42	0.44	0.45	0.46	0.46	0.48	0.48	0.47
			Sones	14.7	14.1	13.8	13.6	13.5	13.4	13.2	12.6	11.9	11.7

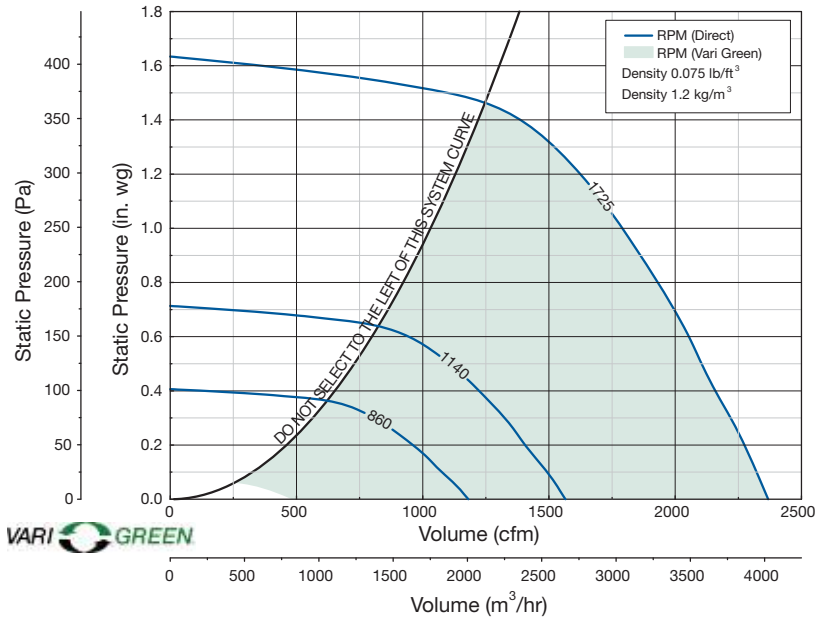
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 130 - Direct Drive



Damper size = 18 x 18 (457 x 457)
 Unit weight** = 77 (35)
 Housing thickness = 18 ga
 Outlet velocity = 0.451 x cfm

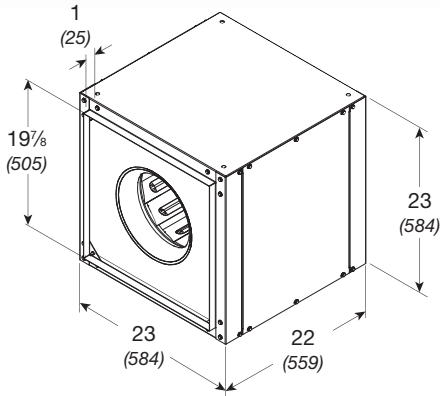
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM		CFM / Static Pressure in Inches wg										
			0.000	0.125	0.250	0.375	0.500	0.625	0.750	1.000	1.250	1.375	
130													
VG-3/4 	C-1/8	860	CFM	1181	1049	891							
			BHP	0.07	0.08	0.08							
			Sones	6.2	5.2	4.5							
	B-1/4	1140	CFM	1565	1472	1367	1249	1105	865				
			BHP	0.16	0.17	0.18	0.18	0.18	0.17				
			Sones	9.4	8.3	7.4	6.8	6.5	6.4				
	A-3/4	1725	CFM	2368	2308	2247	2175	2105	2039	1961	1791	1559	1409
			BHP	0.54	0.56	0.57	0.59	0.60	0.62	0.62	0.63	0.61	0.59
			Sones	17.4	17.6	17.1	17.1	16.6	16.4	15.9	15.7	15.6	15.6

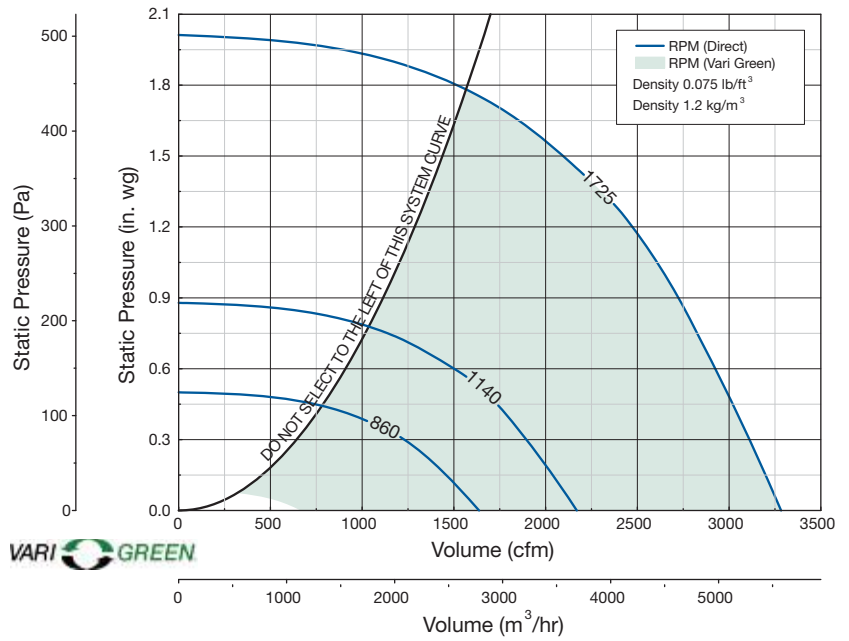
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 140 - Direct Drive



Damper size = 20 x 20 (508 x 508)
 Unit weight** = 104 (47)
 Housing thickness = 18 ga
 Outlet velocity = 0.364 x cfm

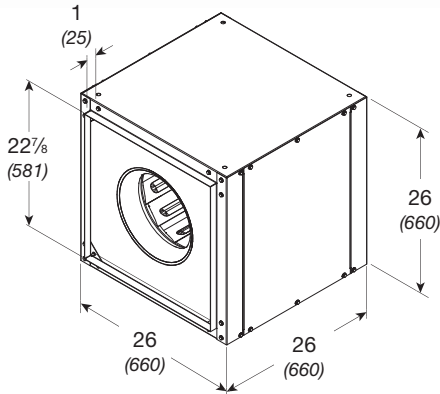
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM		CFM / Static Pressure in Inches wg										
			0.000	0.250	0.375	0.500	0.625	0.750	1.000	1.375	1.500	1.75	
140													
VARI GREEN VG-3/4	C-1/8	860	CFM	1637	1317	1033							
			BHP	0.12	0.13	0.13							
			Sones	7.0	6.2	5.9							
	B-1/3	1140	CFM	2170	1942	1818	1667	1447	1122				
			BHP	0.270	0.290	0.300	0.300	0.300	0.270				
			Sones	10.8	10.1	10.0	9.8	9.6	9.4				
		1550	CFM	2950	2790	2703	2614	2524	2429	2188	1553		
			BHP	0.67	0.71	0.72	0.74	0.75	0.75	0.75	0.69		
			Sones	16.7	16.2	15.8	15.6	15.5	15.3	14.8	13.7		
VG-1	A-1	1725	CFM	3284	3140	3065	2985	2906	2826	2646	2268	2085	1625
			BHP	0.930	0.970	0.980	1.000	1.010	1.030	1.030	1.030	1.010	0.930
			Sones	20	19.3	19.0	18.7	18.6	18.4	18.2	17.2	16.7	15.9

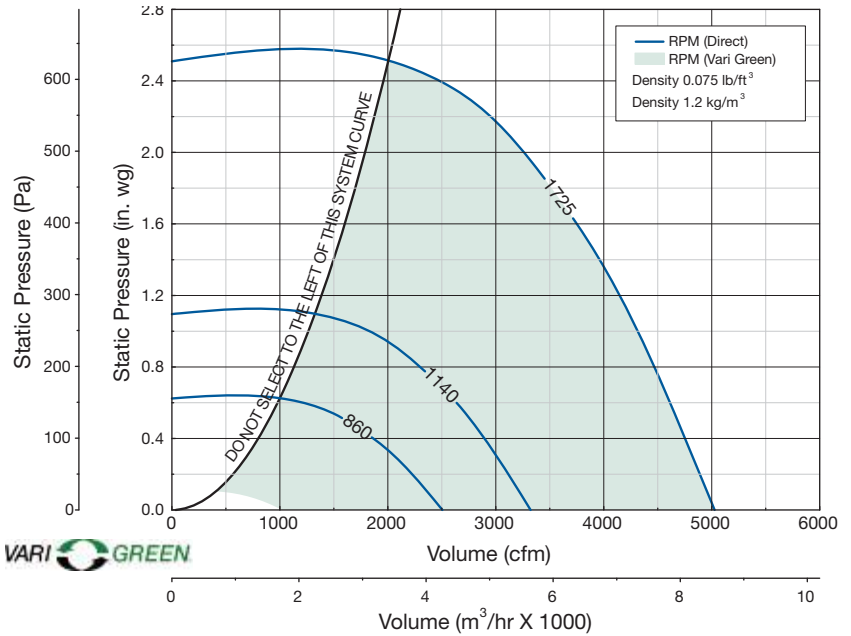
Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

SQ 160 - Direct Drive



Damper size = 23 x 23 (584 x 584)
 Unit weight** = 160 (73)
 Housing thickness = 18 ga
 Outlet velocity = 0.275 x cfm

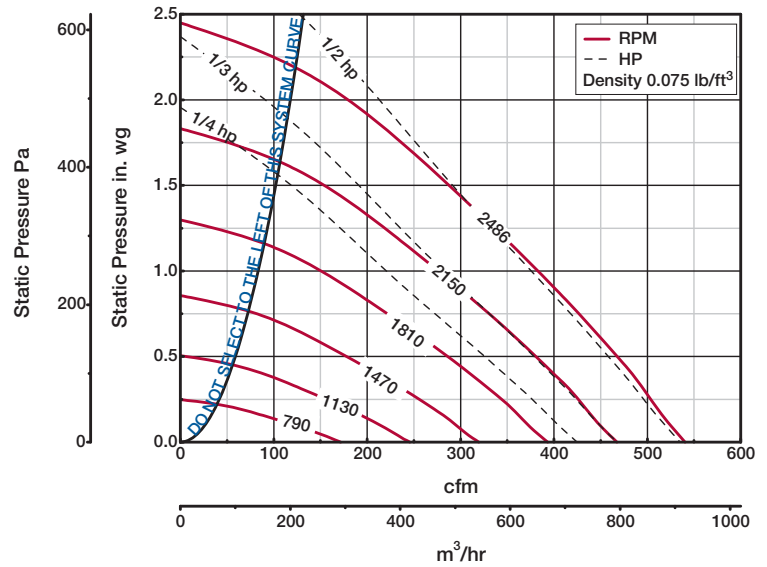
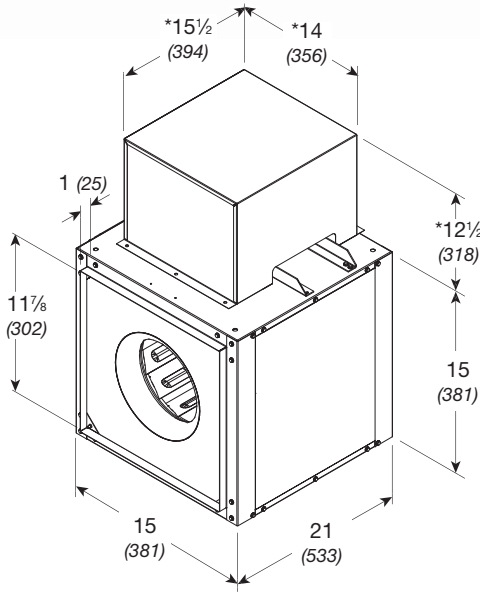
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 **Weight shown is largest cataloged Open Drip Proof motor.



Motor HP	Fan RPM	CFM / Static Pressure in Inches wg											
		0.000	0.250	0.500	0.750	1.000	1.250	1.500	1.750	1.875	2.000		
160													
VG-3/4	C-1/4	860	CFM	2506	2148	1605							
			BHP	0.20	0.23	0.24							
			Sones	8.8	7.2	6.5							
VG-1	B-1/2	1140	CFM	3322	3062	2773	2388	1808					
			BHP	0.470	0.510	0.540	0.560	0.510					
			Sones	14.0	12.8	11.9	11.4	10.8					
VG-1	A-2	1300	CFM	3788	3562	3320	3033	2685	2223				
			BHP	0.70	0.74	0.78	0.81	0.84	0.79				
			Sones	16.8	15.8	14.8	14.5	14.1	13.7				
VG-2	A-2	1725	CFM	5027	4857	4684	4504	4312	4094	3845	3575	3414	3236
			BHP	1.64	1.69	1.74	1.80	1.85	1.89	1.93	1.95	1.94	1.91
			Sones	26	25	24	24	24	24	24	24	24	24

Performance certified is for installation type B: Free inlet, Ducted outlet. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 70 - Belt Drive



Damper size = 12 x 12 (305 x 305)
 Unit weight** = 76 (34)
 Housing thickness = 18 ga

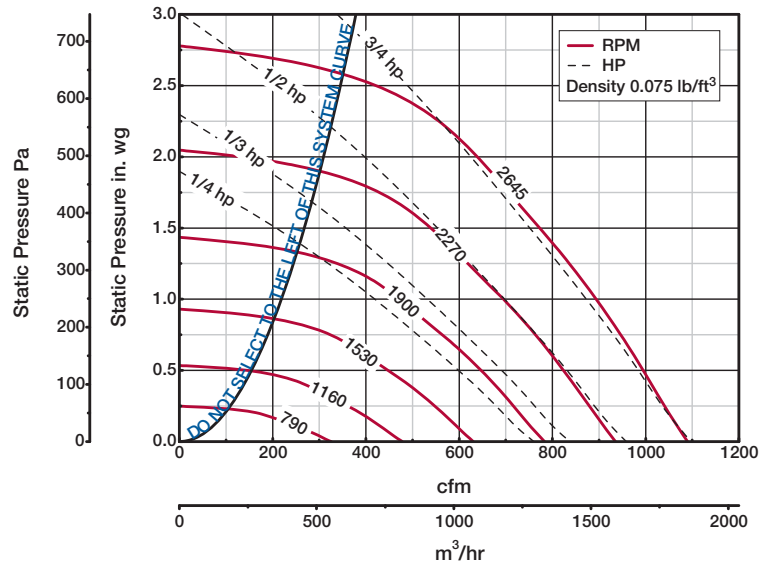
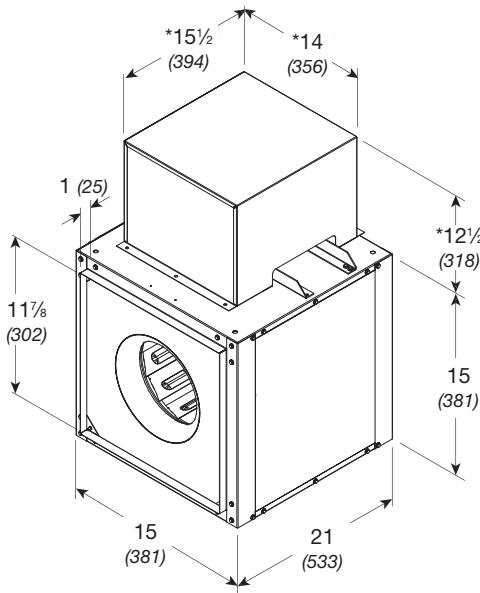
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.625	0.750	1.000	1.250	1.500	1.750	2.000	
70													
70-4	1/4	1050	CFM	184	129								
			BHP	0.039	0.037								
			Sones	8.0	7.5								
		1313	CFM	251	211	117							
			BHP	0.077	0.076	0.068							
			Sones	11.0	10.4	9.2							
		1445	CFM	284	249	169	122						
			BHP	0.103	0.102	0.097	0.09						
			Sones	12.8	12.3	10.7	10.3						
		1577	CFM	314	284	213	175	131					
			BHP	0.13	0.13	0.13	0.12	0.12					
			Sones	14.9	14.6	12.7	11.9	11.4					
1709	CFM	345	318	254	220	184	97						
	BHP	0.17	0.17	0.17	0.16	0.16	0.14						
	Sones	16.1	15.9	14.5	13.9	13.3	12.4						
1840	CFM	375	351	293	262	231	159						
	BHP	0.21	0.21	0.21	0.21	0.20	0.19						
	Sones	17.3	17.0	16.4	16.0	15.4	14.5						
1972	CFM	405	384	331	302	273	212	142					
	BHP	0.26	0.26	0.26	0.25	0.25	0.24	0.22					
	Sones	19.2	19.1	18.6	18.2	17.9	17.7	16.5					
70-3	1/3	2072	CFM	428	408	360	332	305	249	184	103		
			BHP	0.30	0.30	0.30	0.30	0.29	0.29	0.27	0.24		
			Sones	20	20	19.9	19.5	19.1	18.5	18.2	16.8		
		2172	CFM	450	431	387	361	335	282	224	161		
			BHP	0.34	0.35	0.35	0.34	0.34	0.33	0.32	0.30		
			Sones	21	21	21	21	20	19.7	19.2	18.8		
70-5	1/2	2329	CFM	486	467	428	406	381	332	283	225	166	
			BHP	0.43	0.43	0.43	0.43	0.42	0.42	0.41	0.39	0.36	
			Sones	23	23	23	23	23	22	21	20	21	
		2486	CFM	521	504	468	447	426	380	334	287	232	176
			BHP	0.52	0.52	0.52	0.52	0.52	0.51	0.50	0.49	0.47	0.44
			Sones	25	25	25	25	25	24	23	22	22	23

MAX Bhp AT A GIVEN RPM = (rpm/3084)³
 MAXIMUM RPM = 2486
 TIP SPEED (ft/min) = rpm x 2.928
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 1.0212 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 80 - Belt Drive



Damper size = 12 x 12 (305 x 305)
 Unit weight** = 79 (36)
 Housing thickness = 18 ga

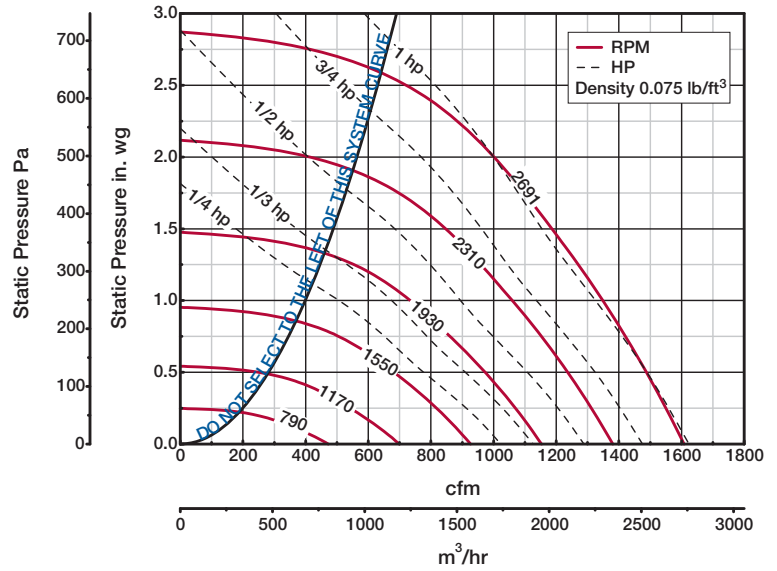
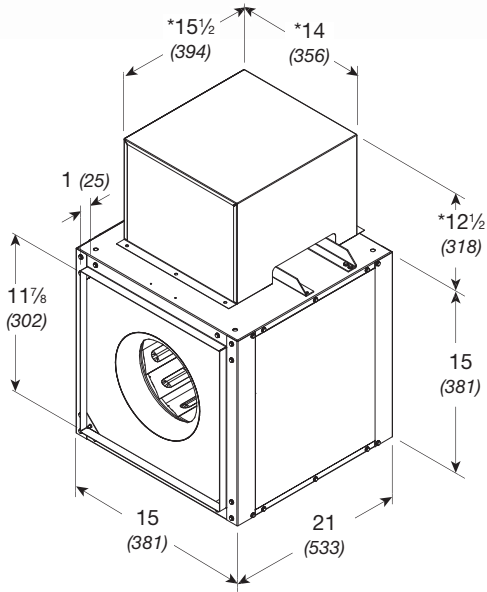
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	
80													
80-4	1/4	1050	CFM	372	298								
			BHP	0.049	0.049								
			Sones	8.0	7.6								
		1207	CFM	445	386	206							
			BHP	0.073	0.075	0.065							
			Sones	9.7	9.1	8.2							
	1520	CFM	585	542	442	301							
		BHP	0.15	0.15	0.15	0.14							
		Sones	13.9	13.5	11.8	10.8							
	1676	CFM	652	615	530	426	254						
		BHP	0.19	0.20	0.20	0.20	0.17						
		Sones	15.9	15.6	14.1	12.9	11.5						
1833	CFM	720	687	613	524	424							
	BHP	0.25	0.26	0.26	0.26	0.25							
	Sones	17.2	16.9	16.3	15.3	14.3							
80-3	1/3	1926	CFM	760	728	660	579	486	346				
			BHP	0.29	0.30	0.30	0.30	0.30	0.27				
			Sones	18.4	18.3	17.8	17.1	16.9	13.9				
		2018	CFM	799	769	704	630	545	452	269			
			BHP	0.34	0.34	0.35	0.35	0.34	0.34	0.28			
			Sones	19.6	19.5	19.2	18.4	18.1	16.7	13.5			
80-5	1/2	2164	CFM	861	833	774	708	633	550	442			
			BHP	0.41	0.42	0.43	0.43	0.43	0.42	0.40			
			Sones	21	21	21	20	19.6	19.2	17.6			
		2310	CFM	924	897	842	784	716	643	563	445		
			BHP	0.50	0.51	0.52	0.52	0.52	0.52	0.51	0.48		
			Sones	23	23	22	23	21	21	20	19.9		
80-7	3/4	2478	CFM	995	969	919	865	807	743	671	597	486	
			BHP	0.62	0.63	0.63	0.64	0.65	0.65	0.64	0.63	0.59	
			Sones	25	25	24	25	24	23	22	22	23	
		2645	CFM	1065	1041	995	945	894	835	773	705	635	395
			BHP	0.75	0.76	0.77	0.78	0.79	0.79	0.78	0.77	0.77	0.65
			Sones	28	28	27	27	27	26	25	24	24	35

MAX Bhp AT A GIVEN RPM = (rpm/2866)³
 MAXIMUM RPM = 2645
 TIP SPEED (ft/min) = rpm x 2.928
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 1.0212 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 90 - Belt Drive



Damper size = 12 x 12 (305 x 305)
 Unit weight** = 84 (38)
 Housing thickness = 18 ga

Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

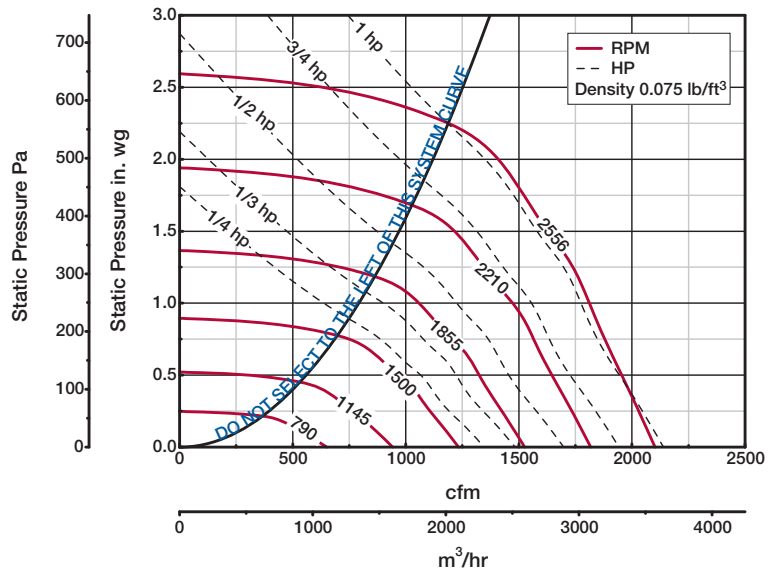
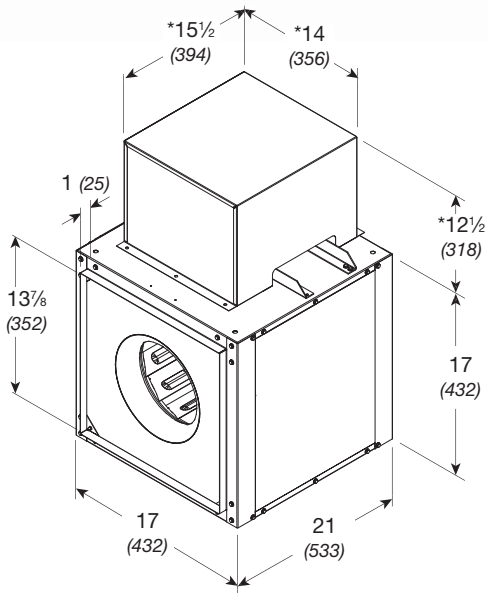
Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.500	1.750	2.000	2.250	2.500	
90													
90-4	1/4	1050	CFM	547	443								
			BHP	0.061	0.061								
			Sones	8.0	7.6								
		1211	CFM	655	574	333							
			BHP	0.092	0.095	0.084							
			Sones	9.8	9.1	8.3							
		1533	CFM	864	806	667	477						
			BHP	0.18	0.19	0.19	0.18						
			Sones	14.2	13.8	12.1	11.0						
		1694	CFM	965	914	798	654	437					
			BHP	0.25	0.25	0.26	0.25	0.22					
			Sones	16.0	15.8	14.4	13.1	12.3					
90-3	1/3	1780	CFM	1019	971	863	734	562					
			BHP	0.29	0.29	0.30	0.30	0.28					
			Sones	16.7	16.5	15.6	14.4	13.7					
		1866	CFM	1072	1028	926	808	657					
			BHP	0.33	0.33	0.35	0.35	0.33					
			Sones	17.5	17.3	16.9	15.9	15.4					
90-5	1/2	2136	CFM	1239	1202	1118	1024	917	638				
			BHP	0.49	0.50	0.51	0.52	0.52	0.47				
			Sones	21	21	21	19.9	19.2	18.4				
90-7	3/4	2291	CFM	1334	1300	1223	1138	1045	811	668			
			BHP	0.61	0.61	0.62	0.64	0.65	0.61	0.58			
			Sones	23	23	22	22	21	20	20			
		2445	CFM	1429	1396	1326	1249	1167	976	844	707		
			BHP	0.73	0.74	0.75	0.77	0.79	0.77	0.73	0.70		
			Sones	25	25	24	25	23	22	22	23		
90-10	1	2568	CFM	1504	1473	1407	1336	1258	1082	977	851	704	
			BHP	0.85	0.86	0.87	0.89	0.90	0.90	0.88	0.84	0.80	
			Sones	26	26	26	26	26	24	22	24	25	
		2691	CFM	1579	1549	1488	1420	1347	1186	1097	987	866	713
			BHP	0.98	0.98	1.00	1.02	1.03	1.05	1.03	1.00	0.96	0.91
			Sones	28	28	27	28	28	26	25	24	26	29

MAX Bhp AT A GIVEN RPM = (rpm/2649)³
 MAXIMUM RPM = 2691
 TIP SPEED (ft/min) = rpm x 2.928
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 1.0212 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).

The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 100 - Belt Drive



Damper size = 14 x 14 (357 x 357)
 Unit weight** = 91 (41)
 Housing thickness = 18 ga

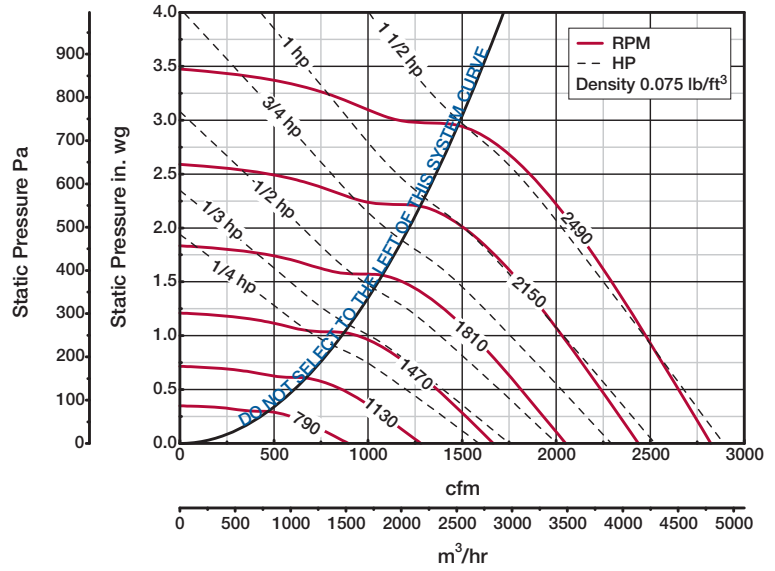
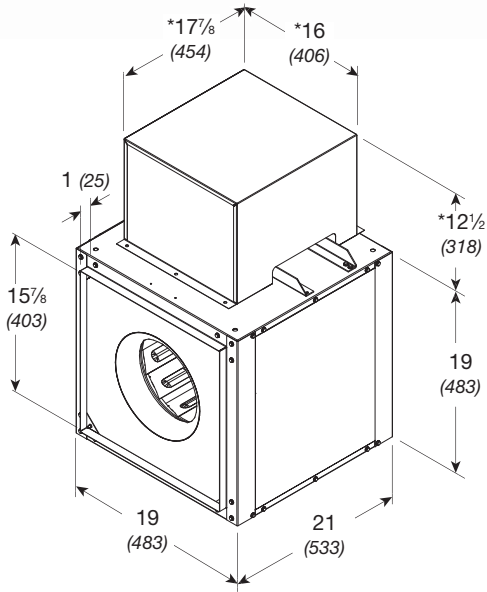
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.625	0.750	1.000	1.250	1.500	1.750	2.000	
100													
100-4	1/4	1050	CFM	774	671								
			BHP	0.072	0.073								
			Sones	7.9	7.6								
		1330	CFM	1024	953	770							
			BHP	0.14	0.15	0.15							
			Sones	11.3	10.6	9.4							
		1469	CFM	1145	1080	931	837						
			BHP	0.19	0.20	0.20	0.20						
			Sones	13.2	12.6	11.0	10.5						
		1609	CFM	1265	1207	1088	1003	917					
			BHP	0.25	0.25	0.26	0.26	0.26					
			Sones	15.4	15.0	13.4	12.4	11.8					
100-3	1/3	1772	CFM	1405	1352	1247	1187	1110	939				
			BHP	0.33	0.34	0.35	0.35	0.35	0.35				
			Sones	16.6	16.4	15.5	14.8	14.3	13.1				
100-5	1/2	1901	CFM	1515	1465	1366	1320	1255	1115				
			BHP	0.40	0.41	0.43	0.43	0.43	0.43				
			Sones	18.0	17.8	17.4	17.1	16.6	16.2				
		2029	CFM	1623	1577	1484	1439	1396	1262	1119			
			BHP	0.49	0.50	0.52	0.52	0.52	0.52	0.52			
			Sones	19.8	19.6	19.4	19.0	18.6	18.2	17.2			
100-7	3/4	2176	CFM	1747	1704	1617	1574	1533	1428	1305	1163		
			BHP	0.60	0.61	0.63	0.64	0.65	0.65	0.65	0.65		
			Sones	21	21	21	21	20	19.8	19.3	18.5		
		2323	CFM	1871	1830	1749	1708	1668	1591	1472	1358	1197	
			BHP	0.73	0.74	0.76	0.78	0.79	0.79	0.79	0.79	0.78	
			Sones	23	23	23	23	23	22	21	20	21	
100-10	1	2440	CFM	1969	1930	1853	1815	1776	1703	1605	1494	1377	1184
			BHP	0.84	0.86	0.88	0.89	0.90	0.91	0.91	0.91	0.91	0.88
			Sones	25	25	24	24	25	23	23	22	22	23
		2556	CFM	2066	2029	1956	1919	1882	1810	1734	1626	1522	1402
			BHP	0.97	0.98	1.01	1.02	1.03	1.05	1.05	1.05	1.05	1.05
			Sones	26	26	25	26	26	25	25	24	22	24

MAX Bhp AT A GIVEN RPM = (rpm/2517)³
 MAXIMUM RPM = 2556
 TIP SPEED (ft/min) = rpm x 2.928
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.7617 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 120 - Belt Drive



Damper size = 16 x 16 (406 x 406)
 Unit weight** = 97 (44)
 Housing thickness = 18 ga

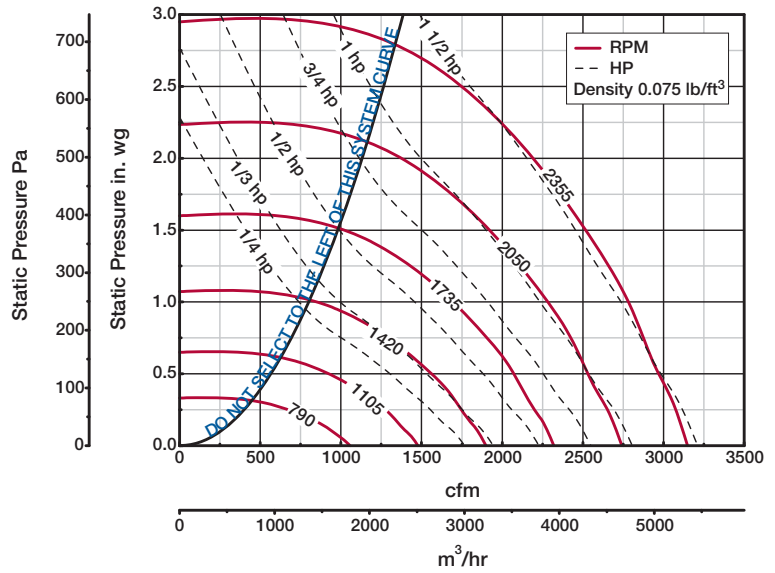
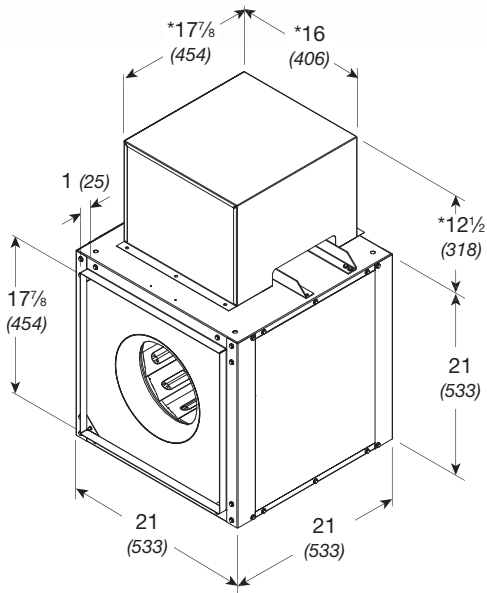
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.375	0.750	1.000	1.250	1.500	2.000	2.250	2.500	2.750	
120													
120-4	1/4	1000	CFM	1026	783								
			BHP	0.096	0.102								
			Sones	7.7	7.5								
		1367	CFM	1471	1311	1020							
			BHP	0.24	0.25	0.26							
			Sones	10.9	10.5	10.0							
120-3	1/3	1437	CFM	1555	1403	1145							
			BHP	0.28	0.29	0.30							
			Sones	11.7	11.3	10.4							
		1506	CFM	1636	1492	1252	1027						
			BHP	0.32	0.33	0.35	0.34						
			Sones	12.5	12.1	11.1	10.2						
120-5	1/2	1615	CFM	1764	1631	1418	1245						
			BHP	0.39	0.41	0.43	0.43						
			Sones	13.8	13.6	12.4	11.8						
		1724	CFM	1892	1767	1571	1423	1241					
			BHP	0.47	0.49	0.52	0.52	0.52					
			Sones	15.2	15.3	13.8	13.6	12.4					
120-7	3/4	1974	CFM	2183	2075	1908	1791	1663	1518				
			BHP	0.71	0.73	0.76	0.78	0.78	0.78				
			Sones	19.0	18.9	17.6	16.9	16.4	15.7				
120-10	1	2073	CFM	2298	2195	2037	1928	1813	1683	1293			
			BHP	0.82	0.84	0.88	0.89	0.91	0.91	0.86			
			Sones	21	21	19.0	18.6	17.9	17.5	15.2			
		2172	CFM	2413	2314	2164	2062	1953	1836	1553			
			BHP	0.94	0.97	1.00	1.02	1.04	1.05	1.03			
			Sones	23	23	21	21	19.7	19.0	17.5			
120-15	1 1/2	2329	CFM	2594	2503	2363	2268	2171	2069	1841	1695	1477	
			BHP	1.16	1.19	1.22	1.25	1.27	1.28	1.29	1.28	1.23	
			Sones	26	26	24	23	23	22	21	19.9	18.8	
		2490	CFM	2779	2694	2563	2475	2387	2294	2093	1984	1852	1682
			BHP	1.41	1.44	1.49	1.51	1.54	1.55	1.58	1.58	1.57	1.53
			Sones	31	30	27	26	27	26	24	23	23	22

MAX Bhp at A GIVEN RPM = (rpm/2144)³
 MAXIMUM RPM = 2490
 TIP SPEED (ft/min) = rpm x 3.436
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.5805 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 130 - Belt Drive



Damper size = 18 x 18 (457 x 457)
 Unit weight** = 97 (44)
 Housing thickness = 18 ga

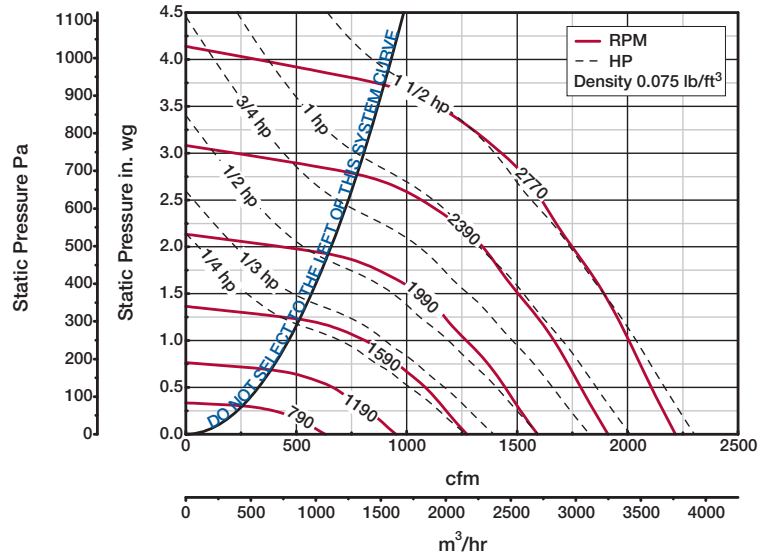
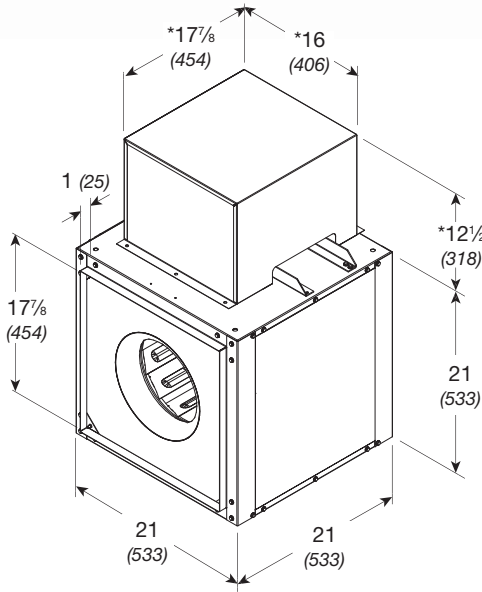
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg											
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500		
130														
130-4	1/4	900	CFM	1084	911									
			BHP	0.086	0.087									
			Sones	7.7	7.7									
	130-4	1/4	1031	CFM	1275	1151	709							
				BHP	0.13	0.13	0.12							
				Sones	8.8	8.7	8.5							
		130-4	1/4	1293	CFM	1652	1563	1328	958					
					BHP	0.24	0.25	0.26	0.24					
					Sones	11.8	11.6	11.2	10.6					
130-3	1/3	1424	CFM	1838	1754	1568	1299							
			BHP	0.32	0.33	0.35	0.34							
			Sones	13.6	13.3	12.8	12.4							
130-5	1/2	1527	CFM	1984	1902	1743	1515	1204						
			BHP	0.40	0.41	0.43	0.42	0.40						
			Sones	14.8	14.5	13.9	13.3	12.6						
	130-5	1/2	1630	CFM	2126	2050	1908	1714	1468	1121				
				BHP	0.48	0.49	0.52	0.52	0.51	0.47				
				Sones	15.9	15.6	15.0	14.3	13.6	12.7				
130-7	3/4	1866	CFM	2448	2389	2266	2128	1949	1740	1462				
			BHP	0.72	0.73	0.76	0.78	0.78	0.76	0.73				
			Sones	19.9	19.5	18.8	18.2	17.2	15.9	14.7				
130-10	1	1960	CFM	2576	2523	2403	2279	2120	1934	1714	1419			
			BHP	0.83	0.84	0.87	0.90	0.91	0.89	0.87	0.83			
			Sones	21	21	19.9	19.3	18.4	17.3	16.7	16.2			
	130-10	1	2053	CFM	2702	2655	2537	2426	2286	2117	1926	1686	1319	
				BHP	0.95	0.96	1.00	1.03	1.05	1.03	1.02	0.99	0.89	
				Sones	23	22	21	20	19.8	18.7	18.0	17.9	18.5	
130-15	1 1/2	2202	CFM	2905	2864	2751	2653	2533	2390	2227	2045	1823		
			HP	1.17	1.18	1.22	1.25	1.28	1.28	1.27	1.26	1.22		
			Sones	26	25	24	22	22	21	20	19.9	21		
	130-15	1 1/2	2355	CFM	3112	3074	2971	2877	2777	2659	2514	2359	2189	1732
				BHP	1.43	1.44	1.48	1.52	1.55	1.58	1.57	1.55	1.54	1.44
				Sones	30	28	28	25	24	23	22	22	22	27

MAX Bhp AT A GIVEN RPM = (rpm/2022)³
 MAXIMUM RPM = 2355
 TIP SPEED (ft/min) = rpm x 3.435
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.4571 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 130HP - Belt Drive



Damper size = 18 x 18 (457 x 457)
 Unit weight** = 97 (44)
 Housing thickness = 18 ga

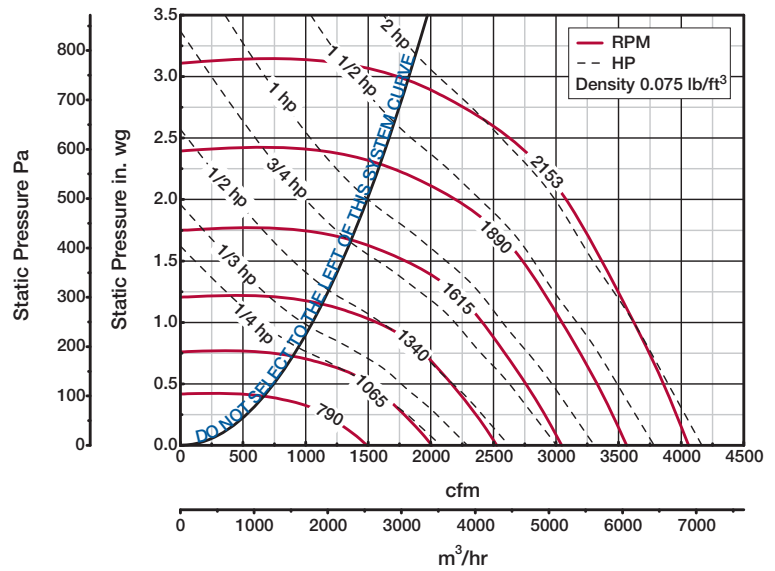
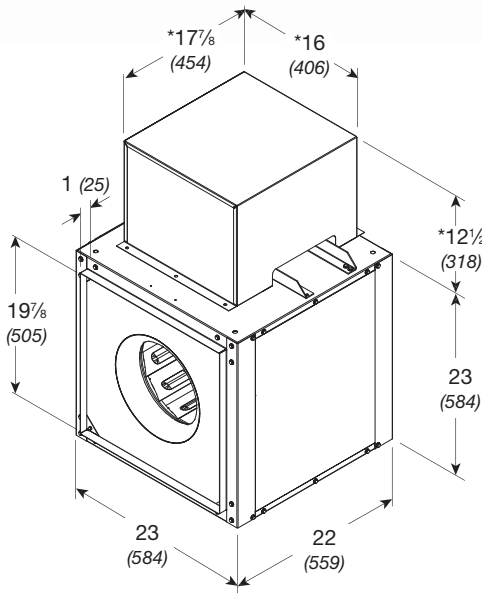
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	3.000	3.500	
130HP													
130HP-4	1/4	1300	CFM	784	549								
			BHP	0.16	0.15								
			Sones	11.2	10.5								
		1520	CFM	1014	884	670							
			BHP	0.25	0.26	0.25							
			Sones	11.4	11.2	10.8							
130HP-3	1/3	1674	CFM	1161	1048	930	700						
			BHP	0.33	0.34	0.35	0.33						
			Sones	12.4	12.5	12.0	11.5						
		1795	CFM	1273	1176	1063	930	691					
			BHP	0.40	0.41	0.42	0.42	0.4					
			Sones	13.3	13.4	13.1	12.6	11.7					
130HP-5	1/2	1916	CFM	1380	1294	1192	1091	925	680				
			BHP	0.48	0.50	0.50	0.52	0.51	0.48				
			Sones	14.6	14.3	14.2	13.9	13.0	11.9				
		2055	CFM	1501	1426	1339	1239	1146	971	756			
			BHP	0.59	0.60	0.62	0.62	0.65	0.62	0.59			
			Sones	16.9	15.9	15.4	15.3	14.9	13.8	12.6			
130HP-7	3/4	2194	CFM	1621	1555	1477	1388	1297	1203	1033			
			BHP	0.71	0.73	0.75	0.76	0.77	0.78	0.76			
			Sones	19.2	18.4	17.1	17.0	17.2	16.5	15.1			
		2304	CFM	1715	1653	1582	1504	1414	1331	1229	865		
			BHP	0.81	0.84	0.86	0.87	0.87	0.90	0.90	0.84		
			Sones	21	20	19.0	18.2	18.6	18.4	17.6	14.5		
130HP-10	1	2414	CFM	1808	1749	1685	1614	1532	1448	1369	1080		
			BHP	0.93	0.95	0.98	1.00	1.01	1.01	1.04	1.00		
			Sones	22	22	21	19.0	19.5	19.7	19.2	16.8		
		2589	CFM	1956	1901	1846	1781	1714	1635	1557	1392	1076	
			BHP	1.14	1.17	1.19	1.22	1.24	1.24	1.25	1.28	1.21	
			Sones	24	25	24	22	21	22	22	20	17.7	
130HP-15	1 1/2	2770	CFM	2108	2056	2005	1950	1888	1825	1750	1608	1421	1110
			BHP	1.39	1.42	1.44	1.47	1.5	1.52	1.52	1.56	1.54	1.48
			Sones	27	28	27	26	25	24	24	23	22	19.2

MAX Bhp AT A GIVEN RPM = (rpm/2377)³
 MAXIMUM RPM = 2770
 TIP SPEED (ft/min) = rpm x 3.435
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.4571 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 140 - Belt Drive



Damper size = 20 x 20 (508 x 508)
 Unit weight** = 111 (50)
 Housing thickness = 18 ga

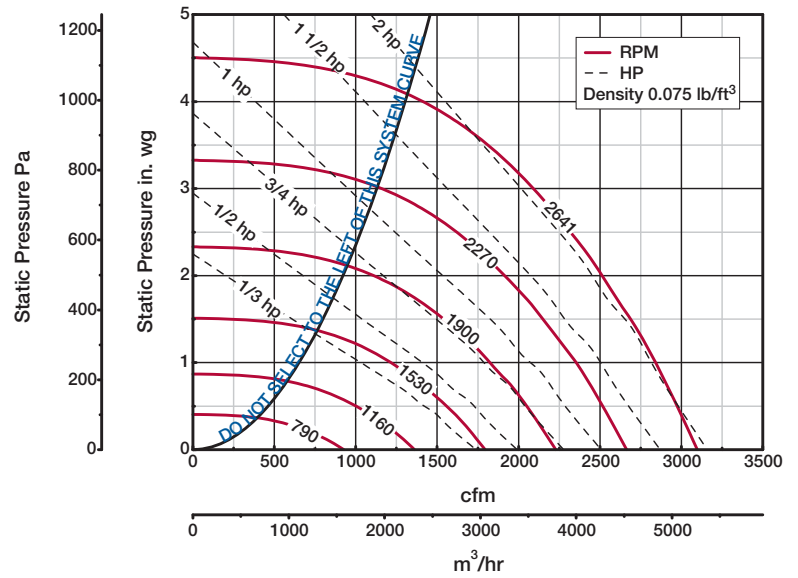
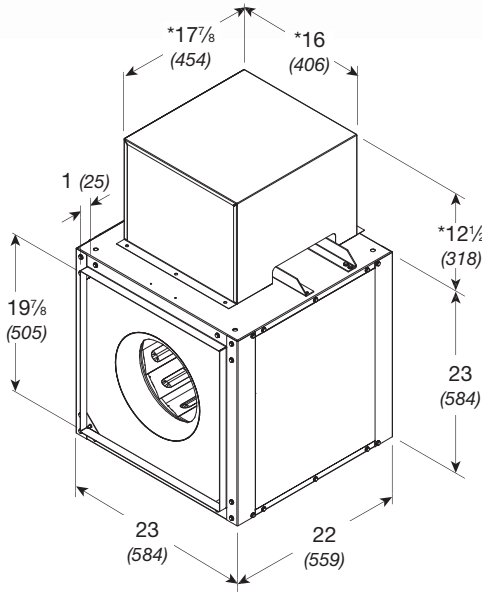
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.500	1.750	2.000	2.500	2.750	
140													
140-4	1/4	800	CFM	1362	1185								
			BHP	0.10	0.11								
			Sones	6.3	6.7								
		1076	CFM	1927	1810	1538							
			BHP	0.24	0.25	0.26							
			Sones	10.7	10.7	10.2							
140-3	1/3	1185	CFM	2142	2039	1807	1463						
			BHP	0.32	0.33	0.35	0.34						
			Sones	12.1	11.9	12.0	10.6						
140-5	1/2	1271	CFM	2311	2217	2006	1741	1199					
			BHP	0.39	0.41	0.43	0.43	0.39					
			Sones	13.3	13.0	13.1	13.0	12.7					
		1356	CFM	2476	2392	2197	1979	1636					
			BHP	0.48	0.49	0.51	0.52	0.51					
			Sones	14.2	13.9	13.8	13.8	13.8					
140-7	3/4	1553	CFM	2858	2787	2626	2449	2253	1447				
			BHP	0.71	0.73	0.75	0.78	0.79	0.70				
			Sones	16.2	16.0	16.0	15.6	15.3	13.9				
140-10	1	1631	CFM	3008	2941	2790	2625	2446	1865				
			BHP	0.82	0.84	0.86	0.89	0.91	0.87				
			Sones	17.1	16.9	16.9	16.6	16.1	14.8				
		1709	CFM	3159	3094	2953	2798	2635	2177	1752			
			BHP	0.95	0.96	0.99	1.02	1.05	1.03	0.97			
			Sones	18.2	18.0	17.9	17.7	17.2	16.1	15.1			
140-15	1 1/2	1956	CFM	3633	3576	3461	3330	3193	2894	2705	2457		
			BHP	1.41	1.43	1.47	1.49	1.53	1.57	1.57	1.55		
			Sones	24	23	24	24	23	22	21	20		
140-20	2	2055	CFM	3822	3769	3662	3537	3410	3136	2982	2777	2168	
			BHP	1.63	1.66	1.70	1.73	1.75	1.82	1.82	1.81	1.70	
			Sones	27	26	28	27	26	25	24	23	21	
		2153	CFM	4009	3958	3856	3741	3622	3365	3225	3078	2627	2260
			BHP	1.88	1.90	1.95	1.98	2.00	2.08	2.10	2.10	2.05	1.95
			Sones	30	30	31	31	30	28	28	27	25	23

MAX Bhp AT A GIVEN RPM = (rpm/1682)³
 MAXIMUM RPM = 2153
 TIP SPEED (ft/min) = rpm x 3.812
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.3692 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 140HP - Belt Drive



Damper size = 20 x 20 (508 x 508)
 Unit weight** = 111 (50)
 Housing thickness = 18 ga

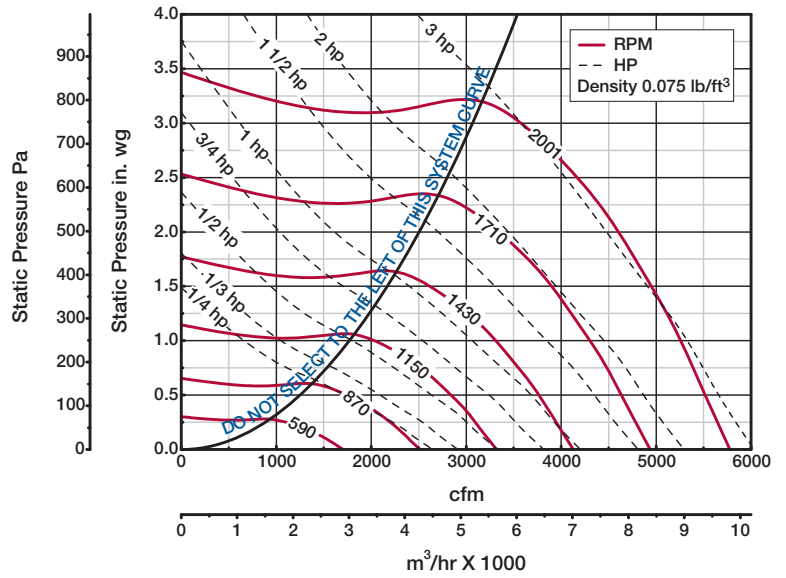
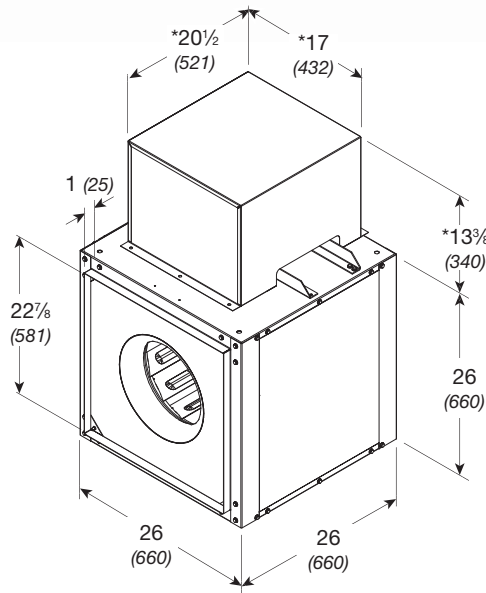
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	3.000	3.500	
140HP													
140HP-3	1/3	1340	CFM	1285	1082								
			BHP	0.27	0.27								
			Sones	11.4	11.2								
		1453	CFM	1449	1281	1058							
			BHP	0.35	0.35	0.34							
			Sones	13.3	12.8	12.4							
140HP-5	1/2	1559	CFM	1601	1452	1270	948						
			BHP	0.42	0.43	0.43	0.39						
			Sones	15.1	14.6	14.2	13.4						
		1664	CFM	1742	1607	1456	1264	800					
			BHP	0.51	0.52	0.52	0.52	0.43					
			Sones	16.5	15.9	15.5	15.0	13.8					
140HP-7	3/4	1785	CFM	1902	1782	1652	1495	1307					
			BHP	0.63	0.64	0.65	0.65	0.64					
			Sones	17.9	17.3	16.7	16.1	15.5					
		1905	CFM	2057	1954	1832	1701	1548	1363				
			BHP	0.76	0.77	0.79	0.79	0.79	0.77				
			Sones	19.7	19.1	18.4	17.7	17.1	16.7				
140HP-10	1	2096	CFM	2298	2211	2108	1998	1878	1741	1581			
			BHP	1.01	1.02	1.03	1.05	1.05	1.05	1.04			
			Sones	24	23	22	21	20	20	19.7			
140HP-15	1½	2197	CFM	2425	2344	2253	2145	2041	1918	1783	1299		
			BHP	1.16	1.18	1.18	1.21	1.21	1.21	1.21	1.08		
			Sones	26	25	24	23	22	22	22	22		
		2399	CFM	2676	2603	2525	2437	2339	2244	2134	1882	1381	
			BHP	1.50	1.52	1.53	1.54	1.57	1.57	1.57	1.56	1.39	
			Sones	30	29	28	27	26	25	24	23	23	
140HP-20	2	2520	CFM	2825	2755	2684	2606	2515	2423	2330	2107	1839	
			BHP	1.73	1.76	1.78	1.78	1.81	1.82	1.82	1.82	1.79	
			Sones	32	31	30	30	28	27	26	25	24	
		2641	CFM	2973	2907	2841	2768	2688	2599	2512	2319	2088	1759
			BHP	1.98	2.01	2.04	2.05	2.06	2.09	2.10	2.10	2.09	2.00
			Sones	33	33	33	32	31	30	29	27	26	24

MAX Bhp AT A GIVEN RPM = (rpm/2064)³
 MAXIMUM RPM = 2641
 TIP SPEED (ft/min) = rpm x 3.812
 MAX NEMA MOTOR FRAME SIZE = 145T
 OUTLET VELOCITY (ft/min) = 0.3692 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 160 - Belt Drive



Damper size = 23 x 23 (584 x 584)
 Unit weight** = 208 (94)
 Housing thickness = 18 ga

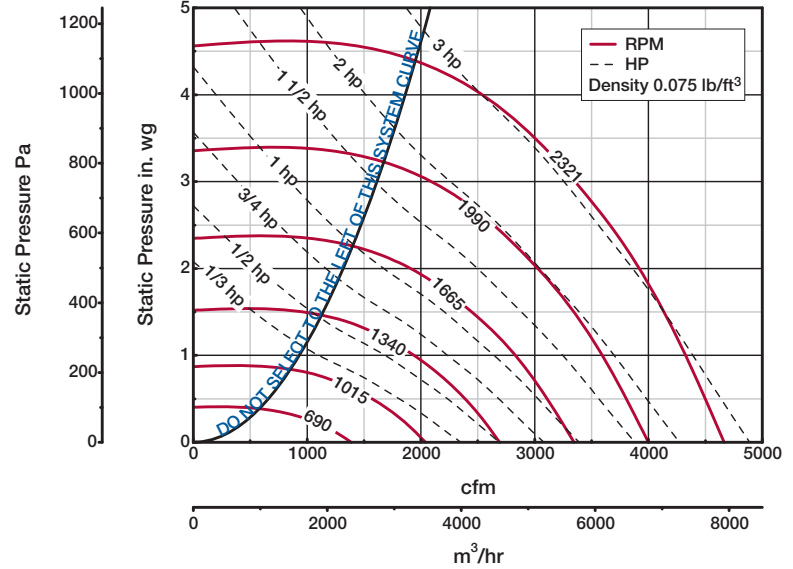
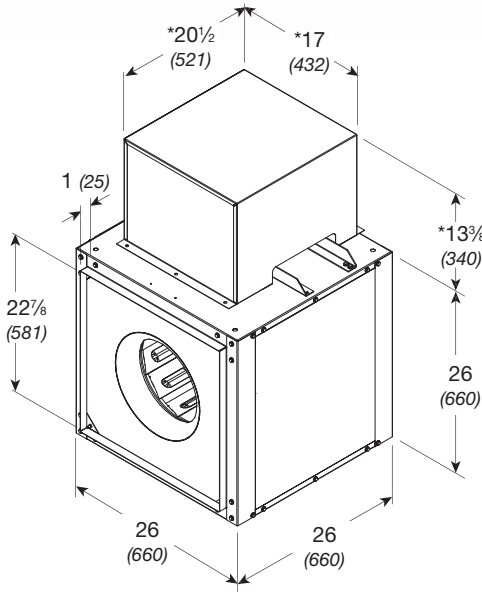
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.500	0.750	1.000	1.500	1.750	2.000	2.250	2.500	3.000	
160													
160-4	1/4	650	CFM	1671									
			BHP	0.10									
			Sones	6.6									
		873	CFM	2373	1759								
			BHP	0.23	0.26								
			Sones	8.8	8.2								
160-3	1/3	962	CFM	2643	2150								
			BHP	0.31	0.35								
			Sones	9.9	9.3								
160-5	1/2	1101	CFM	3061	2665	2301							
			BHP	0.46	0.51	0.52							
			Sones	12.4	11.4	11.2							
160-7	3/4	1261	CFM	3538	3212	2946	2611						
			BHP	0.68	0.74	0.78	0.78						
			Sones	15.5	14.6	14.4	13.2						
160-10	1	1387	CFM	3911	3628	3402	3146	2311					
			BHP	0.90	0.97	1.01	1.04	0.96					
			Sones	18.0	17.2	16.9	16.1	13.1					
160-15	1 1/2	1488	CFM	4209	3949	3745	3519	2921	2420				
			BHP	1.10	1.18	1.23	1.27	1.27	1.17				
			Sones	19.9	19.0	18.9	18.4	15.9	14.5				
		1588	CFM	4503	4259	4079	3880	3389	3055	2566			
			BHP	1.33	1.42	1.47	1.52	1.56	1.53	1.42			
			Sones	22	21	22	21	18.9	17.5	16.1			
160-20	2	1748	CFM	4973	4751	4603	4425	4037	3802	3528	3185		
			BHP	1.77	1.88	1.92	1.98	2.08	2.09	2.07	2.01		
			Sones	28	26	27	27	24	23	22	19.9		
160-30	3	1875	CFM	5345	5138	5000	4847	4501	4312	4091	3844	3530	
			BHP	2.18	2.30	2.35	2.41	2.53	2.57	2.58	2.56	2.50	
			Sones	33	31	31	32	30	29	27	25	23	
		2001	CFM	5713	5519	5390	5260	4946	4774	4596	4392	4160	3566
			BHP	2.64	2.77	2.84	2.89	3.03	3.08	3.12	3.14	3.12	2.99
			Sones	40	36	36	38	38	36	34	31	29	26

MAX Bhp AT A GIVEN RPM = (rpm/1366)³
 MAXIMUM RPM = 2001
 TIP SPEED (ft/min) = rpm x 4.384
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.2782 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 160HP - Belt Drive



Damper size = 23 x 23 (584 x 584)
 Unit weight** = 208 (94)
 Housing thickness = 18 ga

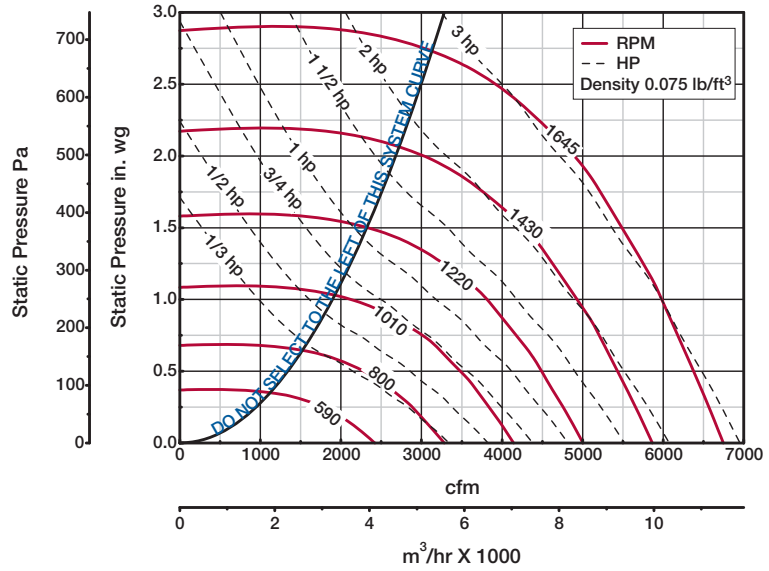
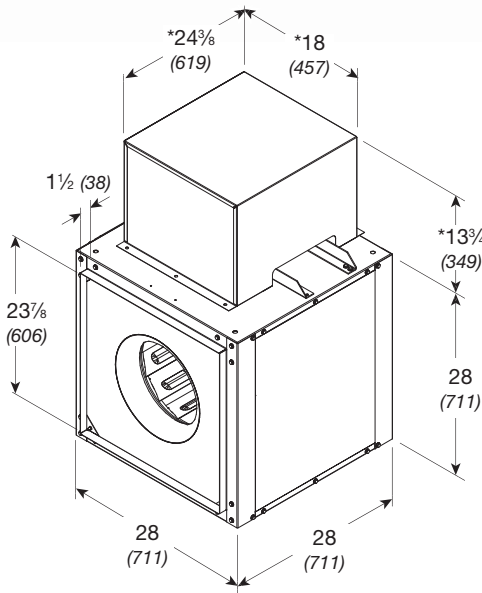
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	2.000	2.500	3.000	3.500	4.000	
160HP													
160HP-3	1/3	1050	CFM	1669	1290								
			BHP	0.29	0.28								
			Sones	7.8	7.2								
		1116	CFM	1844	1533								
			BHP	0.35	0.35								
			Sones	8.6	8.0								
160HP-5	1/2	1277	CFM	2237	2020	1731	1305						
			BHP	0.50	0.52	0.52	0.49						
			Sones	10.8	10.1	9.6	8.9						
160HP-7	3/4	1462	CFM	2664	2497	2299	2050	1720					
			BHP	0.74	0.77	0.79	0.78	0.76					
			Sones	14.1	13.4	12.9	12.7	12.6					
160HP-10	1	1609	CFM	2986	2845	2688	2497	2269	1601				
			BHP	0.97	1.00	1.03	1.05	1.04	0.97				
			Sones	17.8	17.3	16.7	16.3	16.4	16.9				
160HP-15	1 1/2	1726	CFM	3239	3116	2974	2814	2630	2157				
			BHP	1.18	1.22	1.25	1.28	1.29	1.26				
			Sones	22	21	21	19.8	19.8	21				
		1842	CFM	3488	3377	3248	3115	2954	2570	2013			
			BHP	1.42	1.47	1.51	1.54	1.56	1.56	1.49			
			Sones	25	24	24	23	22	23	25			
160HP-20	2	1935	CFM	3686	3580	3464	3338	3200	2859	2435			
			BHP	1.63	1.68	1.73	1.77	1.80	1.82	1.79			
			Sones	27	25	25	25	24	24	25			
		2027	CFM	3881	3780	3676	3555	3434	3135	2763	2248		
			BHP	1.87	1.92	1.97	2.01	2.05	2.09	2.07	1.99		
			Sones	28	28	25	27	26	26	27	28		
160HP-30	3	2174	CFM	4191	4097	4002	3897	3785	3536	3230	2866	2357	
			BHP	2.29	2.34	2.40	2.45	2.49	2.56	2.58	2.55	2.44	
			Sones	32	31	28	28	29	29	29	30	31	
		2321	CFM	4499	4411	4322	4234	4129	3918	3660	3351	3001	2505
			BHP	2.77	2.83	2.89	2.95	3.00	3.09	3.14	3.13	3.09	2.97
			Sones	36	34	34	28	31	32	33	33	33	34

MAX Bhp AT A GIVEN RPM = (rpm/1584)³
 MAXIMUM RPM = 2321
 TIP SPEED (ft/min) = rpm x 4.384
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.2782 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 180 - Belt Drive



Damper size = 24 x 24 (610 x 610)
 Unit weight** = 245 (111)
 Housing thickness = 18 ga

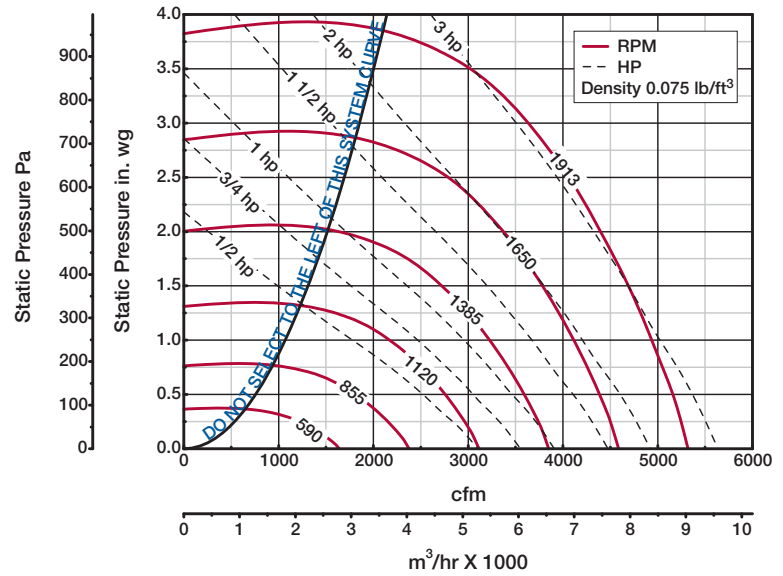
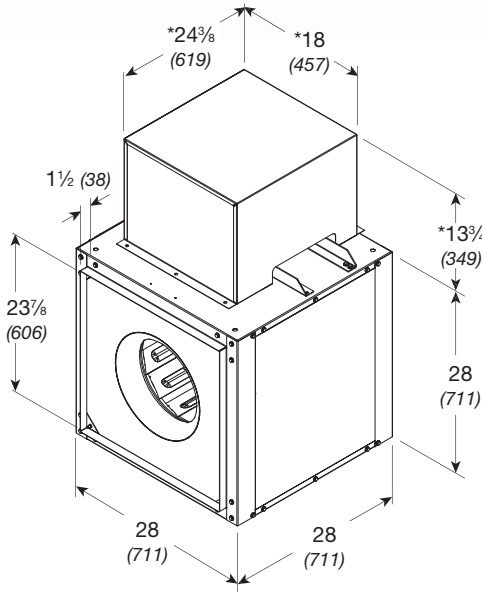
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	
180													
180-3	1/3	700	CFM	2649	2387								
			BHP	0.23	0.24								
			Sones	10.0	9.6								
		791	CFM	3051	2845	2217							
			BHP	0.32	0.34	0.35							
			Sones	10.6	10.9	9.6							
180-5	1/2	905	CFM	3546	3366	2928	2175						
			BHP	0.48	0.49	0.52	0.49						
			Sones	12.2	12.1	11.6	10.8						
180-7	3/4	1037	CFM	4109	3955	3616	3179	2432					
			BHP	0.71	0.73	0.77	0.79	0.73					
			Sones	14.5	14.2	13.5	13.4	12.8					
180-10	1	1141	CFM	4549	4412	4127	3760	3290	2523				
			BHP	0.94	0.96	1.01	1.04	1.04	0.96				
			Sones	16.5	16.1	15.4	15.0	14.9	13.8				
180-15	1 1/2	1224	CFM	4898	4774	4507	4194	3836	3300	2331			
			BHP	1.15	1.18	1.23	1.28	1.29	1.27	1.08			
			Sones	18.4	17.7	17.1	16.5	16.5	15.8	14.4			
		1306	CFM	5242	5128	4878	4610	4281	3884	3332			
			BHP	1.40	1.43	1.48	1.53	1.56	1.57	1.50			
			Sones	20	19.5	18.8	18.3	17.8	17.5	16.8			
180-20	2	1372	CFM	5519	5410	5174	4937	4630	4308	3854	3218		
			BHP	1.62	1.65	1.71	1.75	1.81	1.82	1.81	1.7		
			Sones	22	21	20	19.8	19.0	18.7	18.3	17.5		
		1437	CFM	5790	5686	5463	5236	4964	4662	4298	3814	3106	
			BHP	1.86	1.89	1.95	2.00	2.06	2.09	2.09	2.04	1.89	
			Sones	23	22	22	21	21	19.7	19.6	19.1	18.2	
180-30	3	1541	CFM	6224	6127	5922	5710	5488	5213	4927	4567	4116	
			BHP	2.29	2.32	2.38	2.45	2.50	2.56	2.58	2.57	2.52	
			Sones	26	25	25	24	24	22	22	21	21	
		1645	CFM	6656	6566	6377	6179	5981	5744	5485	5216	4866	3898
			BHP	2.78	2.81	2.88	2.95	3.01	3.07	3.12	3.14	3.13	2.94
			Sones	29	28	28	27	27	26	24	24	24	23

MAX Bhp at A GIVEN RPM = (rpm/1125)³
 MAXIMUM RPM = 1645
 TIP SPEED (ft/min) = rpm x 4.843
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.2553 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 180HP - Belt Drive



Damper size = 24 x 24 (610 x 610)
 Unit weight** = 245 (111)
 Housing thickness = 18 ga

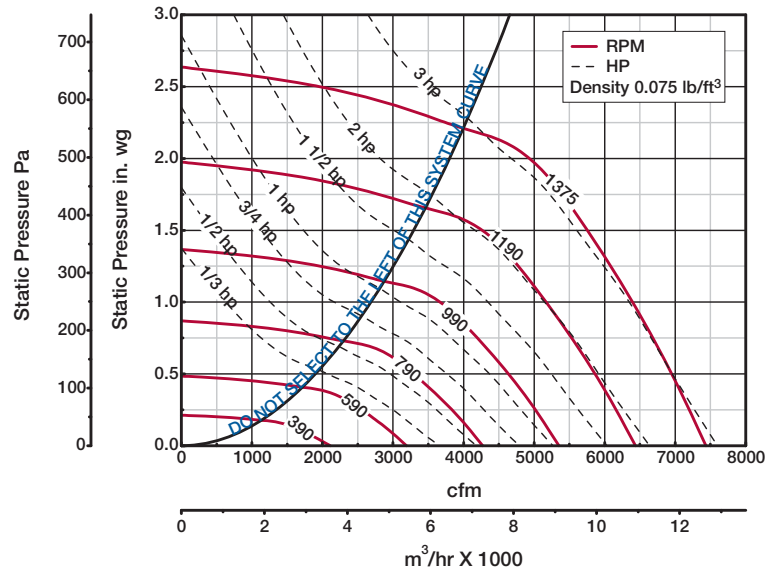
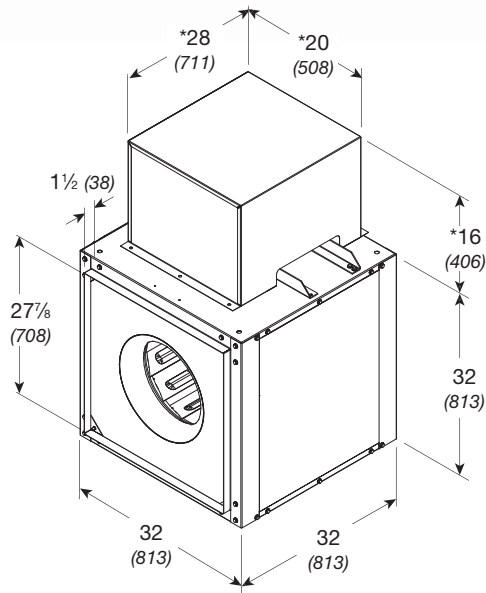
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	3.000	3.500	
180HP													
180HP-5	1/2	1000	CFM	2352	2018								
			BHP	0.44	0.45								
			Sones	10.9	10.0								
		1083	CFM	2636	2364	1984							
			BHP	0.55	0.57	0.56							
			Sones	12.1	11.2	10.5							
180HP-7	3/4	1166	CFM	2907	2672	2379	1951						
			BHP	0.67	0.70	0.71	0.69						
			Sones	13.4	12.6	11.7	10.9						
		1249	CFM	3169	2964	2724	2406	1945					
			BHP	0.81	0.85	0.87	0.87	0.82					
			Sones	14.7	14.1	13.2	12.4	11.4					
180HP-10	1	1332	CFM	3428	3247	3032	2782	2458	1513				
			BHP	0.98	1.02	1.05	1.06	1.05	0.83				
			Sones	16.3	15.7	14.8	14.0	13.1	11.0				
180HP-15	1 1/2	1415	CFM	3681	3518	3328	3116	2857	2537				
			BHP	1.15	1.20	1.24	1.26	1.27	1.26				
			Sones	18.0	17.4	16.6	15.6	14.8	14.0				
		1498	CFM	3931	3782	3614	3423	3212	2944	2622			
			BHP	1.35	1.41	1.45	1.49	1.51	1.50	1.48			
			Sones	19.9	19.1	18.6	17.6	16.8	15.9	15.0			
180HP-20	2	1581	CFM	4180	4043	3893	3718	3528	3312	3049			
			BHP	1.57	1.64	1.69	1.73	1.76	1.77	1.77			
			Sones	22	21	20	19.7	18.9	18.2	17.3			
		1664	CFM	4425	4298	4158	4003	3833	3648	3429	2859		
			BHP	1.81	1.89	1.95	1.99	2.03	2.06	2.07	2.01		
			Sones	24	23	23	22	21	21	19.7	17.9		
180HP-30	3	1747	CFM	4669	4550	4421	4285	4125	3956	3780	3308	2100	
			BHP	2.08	2.16	2.23	2.29	2.33	2.36	2.39	2.38	1.94	
			Sones	27	26	25	24	24	23	23	21	16.9	
		1913	CFM	5155	5050	4938	4816	4691	4545	4396	4058	3620	3006
			BHP	2.70	2.78	2.88	2.95	3.00	3.05	3.09	3.14	3.12	2.96
			Sones	33	32	31	30	30	29	29	28	26	23

MAX Bhp at A GIVEN RPM = (rpm/1306)³
 MAXIMUM RPM = 1913
 TIP SPEED (ft/min) = rpm x 4.843
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.2553 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 200 - Belt Drive



Damper size = 28 x 28 (711 x 711)
 Unit weight** = 314 (142)
 Housing thickness = 18 ga

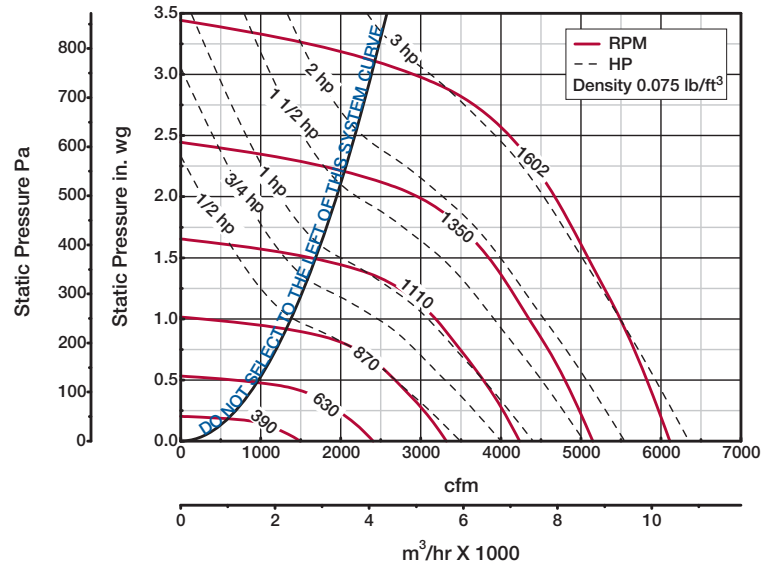
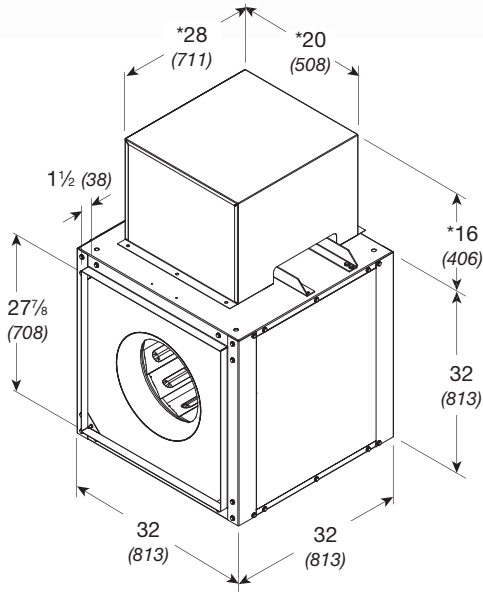
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	0.875	1.000	1.250	1.500	1.750	2.000	
200													
200-3	1/3	600	CFM	2960	2616								
			BHP	0.25	0.26								
			Sones	11.1	10.6								
		660	CFM	3315	3018	2042							
			BHP	0.33	0.34	0.33							
			Sones	11.7	11.2	10.5							
200-5	1/2	756	CFM	3867	3624	3036							
			BHP	0.49	0.50	0.52							
			Sones	12.7	12.0	11.7							
200-7	3/4	811	CFM	4179	3959	3442	2563						
			BHP	0.60	0.62	0.64	0.62						
			Sones	13.4	12.8	12.3	13.0						
		865	CFM	4484	4285	3812	3239	2516					
			BHP	0.73	0.75	0.77	0.79	0.72					
			Sones	14.1	13.7	13.1	13.0	13.9					
200-10	1	952	CFM	4972	4796	4391	3916	3646	3203				
			BHP	0.96	0.99	1.01	1.04	1.05	1.03				
			Sones	15.7	15.5	15.1	14.9	14.5	14.4				
200-15	1 1/2	1090	CFM	5741	5587	5253	4874	4672	4452	3878			
			BHP	1.43	1.47	1.51	1.53	1.55	1.56	1.56			
			Sones	19.1	18.9	18.7	18.5	18.6	18.7	17.3			
200-20	2	1145	CFM	6046	5899	5588	5240	5047	4855	4413	3580		
			BHP	1.66	1.69	1.74	1.77	1.79	1.81	1.82	1.73		
			Sones	21	20	20	20	20	20	19.2	18.6		
		1200	CFM	6350	6210	5920	5597	5416	5233	4836	4316		
			BHP	1.90	1.94	2.00	2.02	2.04	2.06	2.09	2.08		
			Sones	22	22	21	21	21	21	21	19.8		
200-30	3	1287	CFM	6830	6699	6439	6138	5988	5818	5475	5088	4557	
			BHP	2.34	2.38	2.46	2.49	2.50	2.52	2.56	2.58	2.56	
			Sones	25	24	24	24	23	23	23	23	22	
		1375	CFM	7314	7192	6948	6677	6537	6396	6076	5753	5379	4862
			BHP	2.85	2.89	2.98	3.02	3.03	3.05	3.09	3.14	3.15	3.13
			Sones	27	27	26	26	26	26	26	25	25	24

MAX Bhp AT A GIVEN RPM = (rpm/937)³
 MAXIMUM RPM = 1375
 TIP SPEED (ft/min) = rpm x 5.595
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.1870 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 200HP - Belt Drive



Damper size = 28 x 28 (711 x 711)
 Unit weight** = 314 (142)
 Housing thickness = 18 ga

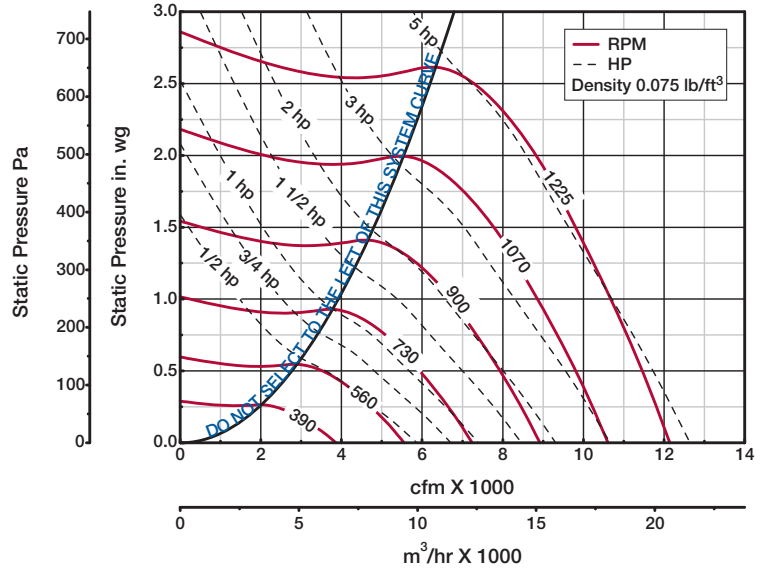
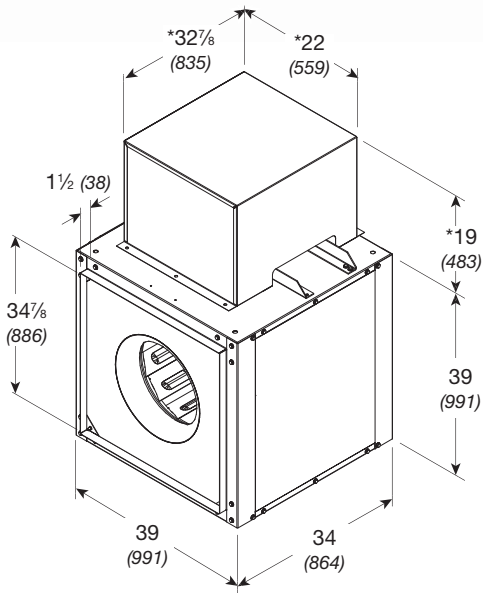
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.250	2.500	3.000	
200HP													
200HP-5	1/2	850	CFM	2580	2037								
			BHP	0.47	0.47								
			Sones	12.3	11.6								
		880	CFM	2724	2258								
			BHP	0.51	0.52								
			Sones	12.8	12.3								
200HP-7	3/4	945	CFM	3032	2656	1943							
			BHP	0.63	0.65	0.61							
			Sones	14.2	14.1	12.4							
		1009	CFM	3327	3003	2556							
			BHP	0.76	0.78	0.78							
			Sones	15.6	15.9	14.7							
200HP-10	1	1111	CFM	3787	3495	3179	2732						
			BHP	1.00	1.03	1.05	1.04						
			Sones	16.9	17.4	16.9	15.3						
200HP-15	1 1/2	1191	CFM	4129	3870	3594	3263	2760					
			BHP	1.22	1.26	1.28	1.29	1.27					
			Sones	17.9	18.0	18.9	17.2	15.7					
		1271	CFM	4466	4235	3979	3716	3379	2808				
			BHP	1.47	1.51	1.55	1.57	1.57	1.52				
			Sones	18.8	18.9	21	19.8	17.5	16.2				
200HP-20	2	1335	CFM	4733	4523	4282	4035	3748	3382	2732			
			BHP	1.69	1.74	1.78	1.81	1.82	1.81	1.72			
			Sones	19.7	19.9	21	22	19.6	17.7	16.5			
		1399	CFM	4998	4803	4578	4344	4108	3802	3409	2702		
			BHP	1.93	1.99	2.03	2.07	2.09	2.09	2.08	1.95		
			Sones	21	21	21	24	22	19.5	18.1	17.0		
200HP-30	3	1467	CFM	5277	5092	4888	4667	4442	4190	3898	3473	2724	
			BHP	2.22	2.28	2.33	2.37	2.40	2.42	2.42	2.39	2.22	
			Sones	23	22	22	24	25	22	19.6	18.7	17.6	
		1602	CFM	5823	5659	5489	5291	5089	4883	4669	4401	4089	2894
			BHP	2.86	2.93	3.00	3.04	3.08	3.12	3.15	3.15	3.14	2.86
			Sones	26	26	25	25	27	27	25	23	22	20

MAX Bhp at A GIVEN RPM = (rpm/1093)³
 MAXIMUM RPM = 1602
 TIP SPEED (ft/min) = rpm x 5.595
 MAX NEMA MOTOR FRAME SIZE = 184T
 OUTLET VELOCITY (ft/min) = 0.1870 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 240 - Belt Drive



Damper size = 35 x 35 (889 x 889)
 Unit weight** = 415 (188)
 Housing thickness = 18 ga

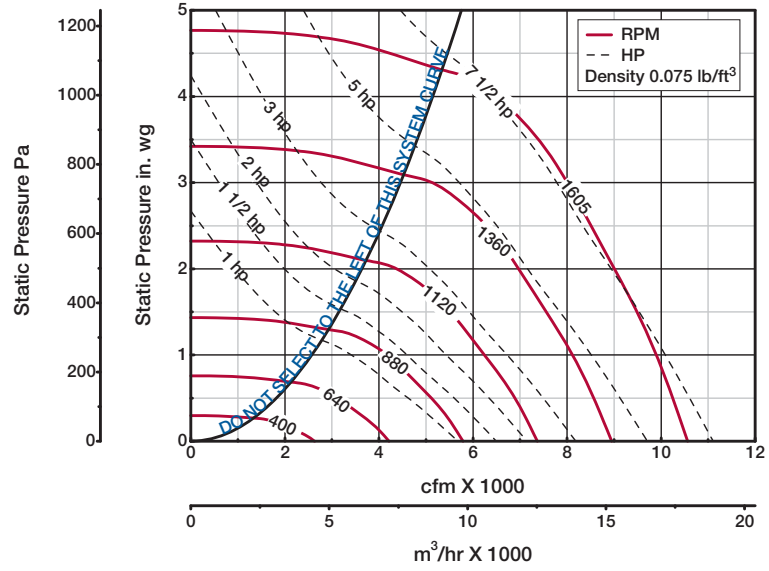
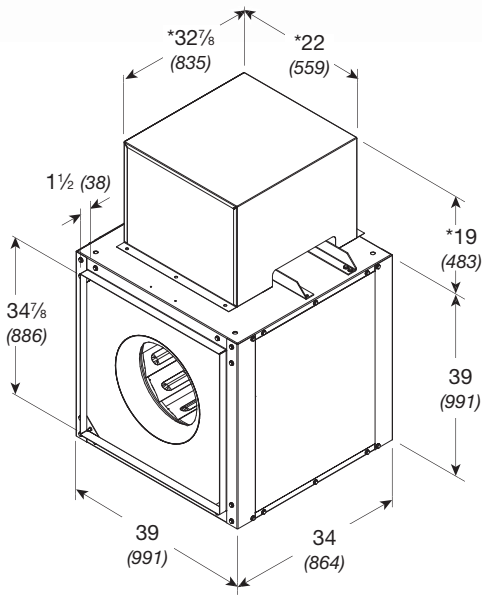
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	
240													
240-5	1/2	500	CFM	4518	4001								
			BHP	0.33	0.35								
			Sones	10.7	10.2								
		569	CFM	5269	4833	3685							
			BHP	0.48	0.51	0.51							
			Sones	12.3	11.8	10.8							
240-7	3/4	651	CFM	6132	5768	4946							
			BHP	0.70	0.74	0.78							
			Sones	14.3	13.9	12.9							
240-10	1	684	CFM	6475	6135	5368	4273						
			BHP	0.81	0.85	0.90	0.89						
			Sones	15.2	14.9	13.8	12.6						
		717	CFM	6816	6498	5782	4884						
			BHP	0.93	0.97	1.03	1.03						
			Sones	16.2	15.9	14.9	13.6						
240-15	1 1/2	826	CFM	7935	7680	7086	6425	5604					
			BHP	1.41	1.45	1.54	1.59	1.58					
			Sones	19.5	19.5	18.7	17.4	16.2					
240-20	2	903	CFM	8720	8488	7960	7384	6756	5889				
			BHP	1.83	1.88	1.97	2.05	2.09	2.05				
			Sones	22	22	22	20	18.9	17.9				
240-30	3	969	CFM	9390	9174	8695	8176	7612	6962	6075			
			BHP	2.25	2.31	2.41	2.50	2.56	2.57	2.52			
			Sones	25	24	24	23	21	20	19.4			
		1034	CFM	10048	9845	9409	8936	8421	7881	7219	6268		
			BHP	2.73	2.79	2.90	3.01	3.08	3.14	3.11	3.03		
			Sones	28	27	27	26	23	22	22	21		
240-50	5	1098	CFM	10694	10503	10105	9660	9192	8695	8160	7510	6451	
			BHP	3.26	3.32	3.44	3.56	3.65	3.72	3.76	3.72	3.58	
			Sones	31	31	30	29	26	24	24	23	22	
		1225	CFM	11973	11802	11460	11070	10671	10245	9804	9345	8797	7124
			BHP	4.50	4.58	4.72	4.84	4.97	5.07	5.16	5.22	5.20	4.95
			Sones	41	40	38	37	34	31	28	28	28	26

MAX Bhp AT A GIVEN RPM = (rpm/706)³
 MAXIMUM RPM = 1225
 TIP SPEED (ft/min) = rpm x 6.414
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.1192 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 240HP - Belt Drive



Damper size = 35 x 35 (889 x 889)
 Unit weight** = 415 (188)
 Housing thickness = 18 ga

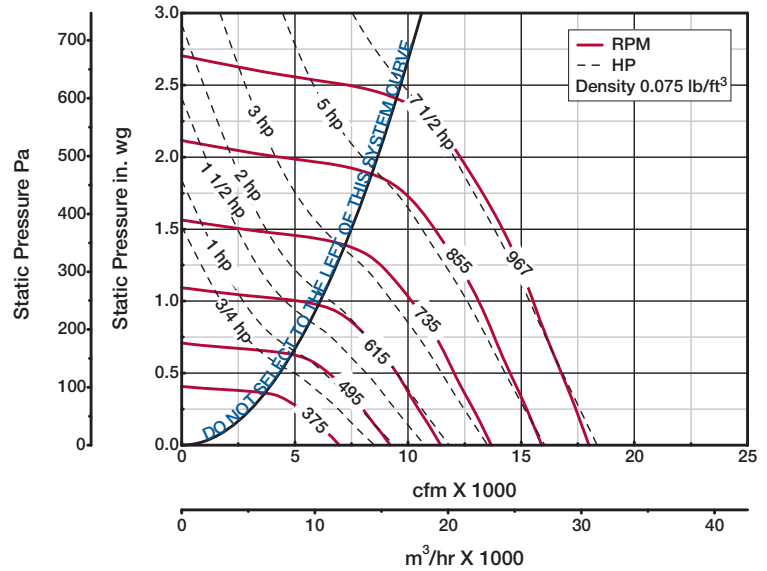
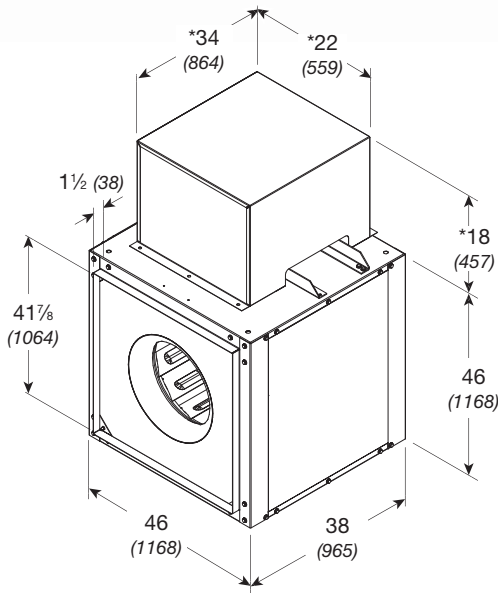
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	
240HP													
240HP-10	1	780	CFM	4321	3791	2789							
			BHP	0.88	0.90	0.83							
			Sones	14.4	14.0	13.5							
		820	CFM	4643	4149	3492							
			BHP	1.01	1.04	1.03							
			Sones	15.2	14.8	14.3							
240HP-15	1 1/2	939	CFM	5552	5159	4721	4161						
			BHP	1.48	1.54	1.57	1.55						
			Sones	18.1	17.3	16.8	16.3						
240HP-20	2	986	CFM	5903	5541	5135	4693	4013					
			BHP	1.69	1.76	1.81	1.82	1.76					
			Sones	19.2	18.2	17.9	17.5	17.0					
		1033	CFM	6251	5909	5533	5128	4609					
			BHP	1.93	2.01	2.07	2.09	2.07					
			Sones	20	19.3	18.9	18.6	18.2					
240HP-30	3	1183	CFM	7336	7046	6747	6419	6073	5209				
			BHP	2.85	2.94	3.02	3.09	3.13	3.10				
			Sones	25	24	22	22	22	21				
240HP-50	5	1256	CFM	7843	7589	7307	7016	6700	6030	4920			
			BHP	3.37	3.48	3.57	3.65	3.72	3.77	3.59			
			Sones	27	26	25	24	23	22	22			
		1329	CFM	8346	8125	7859	7593	7304	6686	5897			
			BHP	3.96	4.09	4.18	4.28	4.35	4.44	4.40			
			Sones	30	28	27	26	25	24	23			
		1402	CFM	8848	8657	8405	8152	7897	7327	6721	5790		
			BHP	4.61	4.76	4.86	4.96	5.06	5.20	5.24	5.09		
			Sones	33	31	30	29	27	25	25	24		
240HP-75	7 1/2	1470	CFM	9313	9132	8908	8667	8427	7901	7334	6622	5565	
			BHP	5.28	5.44	5.57	5.67	5.77	5.94	6.02	5.97	5.70	
			Sones	36	34	32	32	31	27	26	25	24	
		1605	CFM	10232	10066	9896	9675	9455	9007	8512	7987	7348	6474
			BHP	6.80	6.98	7.16	7.27	7.38	7.60	7.78	7.84	7.80	7.57
			Sones	43	42	39	38	38	34	30	29	28	27

MAX Bhp AT A GIVEN RPM = (rpm/807)³
 MAXIMUM RPM = 1605
 TIP SPEED (ft/min) = rpm x 6.414
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.1192 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 300 - Belt Drive



Damper size = 42 x 42 (1067 x 1067)
 Unit weight** = 537 (244)
 Housing thickness = 16 ga

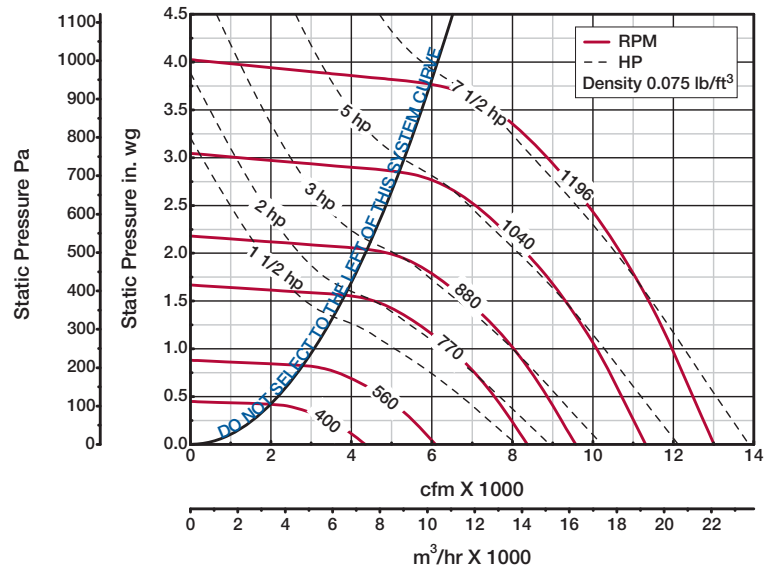
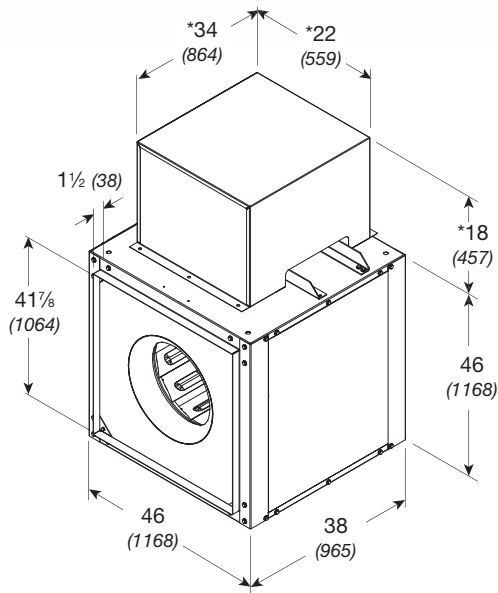
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.250	
300HP													
300-7	3/4	410	CFM	6897	6141								
			BHP	0.57	0.60								
			Sones	10.4	10.3								
		449	CFM	7693	7033	4827							
			BHP	0.75	0.78	0.73							
			Sones	12.2	11.6	10.5							
300-10	1	494	CFM	8598	7982	6450							
			BHP	0.99	1.02	1.04							
			Sones	14.7	13.8	12.0							
300-15	1 1/2	566	CFM	10022	9469	8363	6662						
			BHP	1.48	1.51	1.57	1.52						
			Sones	17.2	16.6	15.1	13.5						
300-20	2	623	CFM	11129	10636	9676	8418						
			BHP	1.96	2.00	2.08	2.09						
			Sones	19.3	19.0	17.7	16.3						
300-30	3	668	CFM	11997	11546	10647	9617	8157					
			BHP	2.40	2.46	2.54	2.59	2.52					
			Sones	21	21	19.8	18.5	17.2					
		713	CFM	12862	12446	11588	10703	9547	7803				
			BHP	2.91	2.97	3.06	3.13	3.13	2.95				
			Sones	23	23	22	21	19.8	18.5				
300-50	5	757	CFM	13704	13321	12496	11714	10727	9442				
			BHP	3.47	3.55	3.64	3.73	3.76	3.68				
			Sones	25	25	24	23	22	21				
		845	CFM	15380	15041	14307	13604	12860	11957	10839	9309		
			BHP	4.80	4.90	5.01	5.12	5.20	5.23	5.16	4.93		
			Sones	27	27	28	27	26	25	24	23		
300-75	7 1/2	906	CFM	16538	16221	15548	14870	14237	13481	12576	11497	10099	
			BHP	5.91	6.00	6.14	6.25	6.37	6.44	6.44	6.34	6.10	
			Sones	30	30	31	30	29	29	27	26	26	
		967	CFM	17693	17396	16776	16124	15526	14888	14171	13273	12242	11047
			BHP	7.17	7.27	7.44	7.55	7.67	7.78	7.85	7.82	7.71	7.50
			Sones	33	33	34	34	33	33	32	30	29	28

MAX Bhp AT A GIVEN RPM = (rpm/486)³
 MAXIMUM RPM = 967
 TIP SPEED (ft/min) = rpm x 7.984
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.0826 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 300HP - Belt Drive



Damper size = 42 x 42 (1067 x 1067)
 Unit weight** = 537 (244)
 Housing thickness = 16 ga

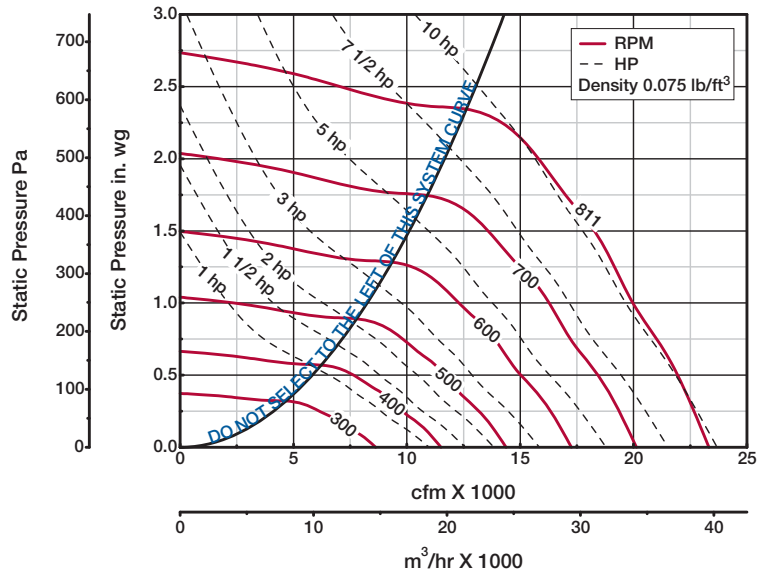
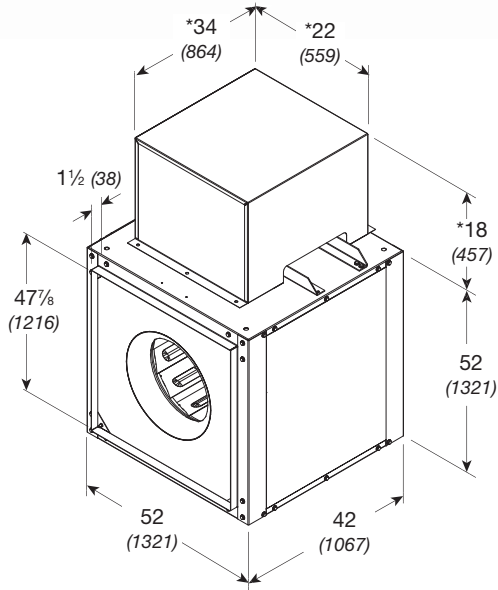
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.500	3.000	3.500	
300HP													
300HP-15	1 1/2	620	CFM	5642	4823								
			BHP	1.06	1.10								
			Sones	14.4	14.0								
		694	CFM	6610	6001	5168	3452						
			BHP	1.44	1.51	1.53	1.36						
			Sones	16.5	16.1	15.8	16.3						
300HP-20	2	725	CFM	6998	6436	5729	4747						
			BHP	1.63	1.71	1.75	1.71						
			Sones	17.5	17.2	16.8	16.6						
		777	CFM	7641	7151	6556	5799	4740					
			BHP	1.98	2.07	2.13	2.15	2.07					
			Sones	19.3	19.1	18.5	18.4	18.2					
300HP-30	3	829	CFM	8265	7830	7317	6701	5940	4535				
			BHP	2.36	2.47	2.56	2.61	2.61	2.40				
			Sones	21	21	21	20	20	20				
		934	CFM	9492	9142	8746	8281	7752	7130	6393			
			BHP	3.29	3.44	3.56	3.65	3.72	3.74	3.71			
			Sones	26	26	26	25	25	25	24			
300HP-50	5	987	CFM	10105	9788	9417	9012	8564	8027	7411	5200		
			BHP	3.85	4.02	4.14	4.25	4.34	4.40	4.41	3.99		
			Sones	27	27	27	26	26	25	25	25		
		1039	CFM	10702	10401	10067	9711	9292	8847	8323	7028		
			BHP	4.45	4.63	4.78	4.90	5.00	5.09	5.14	5.09		
			Sones	28	27	27	27	26	26	26	25		
1091	CFM	11297	11010	10710	10371	10006	9601	9149	8055	6257			
	BHP	5.11	5.30	5.48	5.61	5.73	5.83	5.91	5.95	5.57			
	Sones	29	28	28	28	27	27	26	26	26			
300HP-75	7 1/2	1144	CFM	11900	11626	11353	11036	10713	10336	9950	9020	7832	
			BHP	5.86	6.05	6.25	6.40	6.54	6.65	6.76	6.88	6.82	
			Sones	29	29	29	29	29	28	27	27	26	
		1196	CFM	12489	12228	11966	11681	11372	11047	10677	9853	8840	7545
			BHP	6.65	6.86	7.06	7.24	7.39	7.53	7.64	7.81	7.85	7.63
			Sones	30	30	30	30	30	29	28	28	28	27

MAX Bhp AT A GIVEN RPM = (rpm/602)³
 MAXIMUM RPM = 1196
 TIP SPEED (ft/min) = rpm x 7.984
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.0826 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 360 - Belt Drive



Damper size = 48 x 48 (1219 x 1219)
 Unit weight** = 686 (311)
 Housing thickness = 16 ga

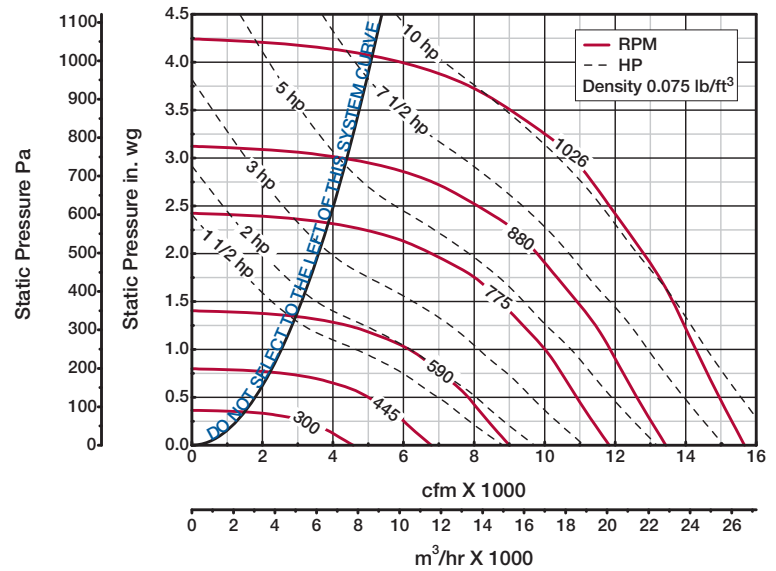
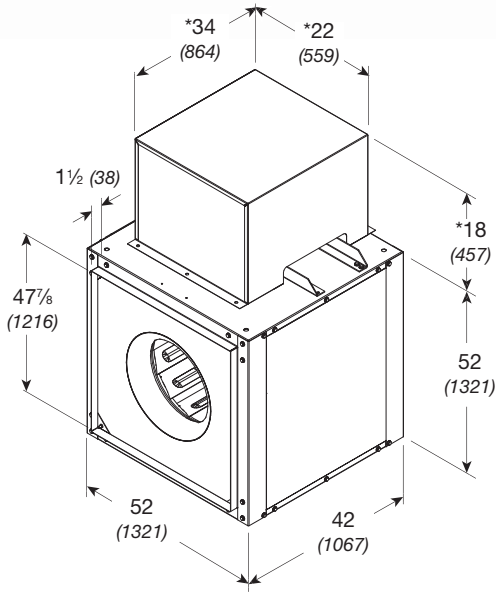
Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.500	0.750	1.000	1.250	1.500	1.750	2.000	2.250	
360													
360-10	1	320	CFM	8205	6979								
			BHP	0.63	0.64								
			Sones	10.8	10.5								
		376	CFM	10039	9008								
			BHP	1.01	1.04								
			Sones	12.6	12.5								
360-15	1 1/2	404	CFM	10898	9941	7828							
			BHP	1.25	1.28	1.25							
			Sones	13.6	13.6	12.2							
		431	CFM	11720	10872	8980							
			BHP	1.51	1.55	1.55							
			Sones	14.7	14.7	13.7							
360-20	2	474	CFM	13018	12323	10736	8489						
			BHP	1.99	2.05	2.09	1.96						
			Sones	16.1	16.6	15.7	14.1						
360-30	3	543	CFM	15081	14544	13112	11627	9553					
			BHP	2.96	3.05	3.12	3.12	2.93					
			Sones	19.1	19.6	19.4	18.1	16.6					
360-50	5	643	CFM	18041	17587	16511	15327	14081	12560				
			BHP	4.87	4.98	5.13	5.19	5.19	5.05				
			Sones	28	27	27	26	25	23				
360-75	7 1/2	690	CFM	19423	19001	18083	16881	15926	14555	13120			
			BHP	6.00	6.12	6.31	6.38	6.45	6.38	6.20			
			Sones	29	29	29	28	28	27	25			
		737	CFM	20802	20407	19615	18505	17515	16475	15153	13704		
			BHP	7.30	7.42	7.66	7.75	7.82	7.84	7.72	7.49		
			Sones	31	31	32	32	31	30	29	28		
360-100	10	774	CFM	21885	21509	20755	19765	18744	17893	16693	15429	13860	
			BHP	8.44	8.57	8.82	8.95	9.03	9.11	9.03	8.86	8.55	
			Sones	32	32	33	34	33	33	32	30	30	
		811	CFM	22967	22607	21888	21011	19986	19146	18195	16996	15786	14128
			BHP	9.69	9.83	10.1	10.27	10.35	10.44	10.45	10.34	10.13	9.73
			Sones	33	34	35	37	36	35	34	33	32	32

MAX Bhp AT A GIVEN RPM = (rpm/370)³
 MAXIMUM RPM = 811
 TIP SPEED (ft/min) = rpm x 9.424
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.0632 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 360HP - Belt Drive



Damper size = 48 x 48 (1219 x 1219)
 Unit weight** = 686 (311)
 Housing thickness = 16 ga

Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

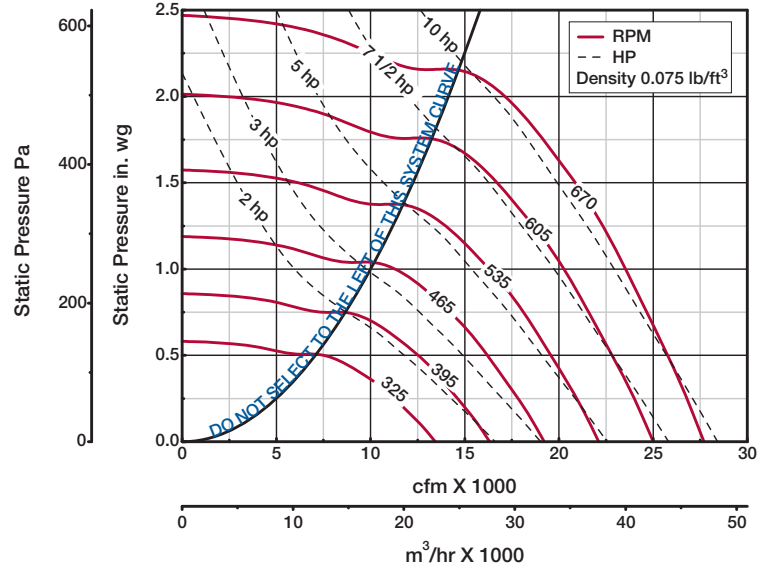
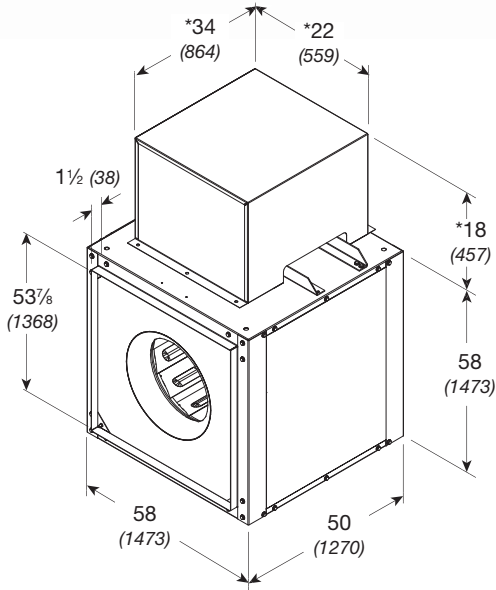
Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.500	0.750	1.000	1.250	1.500	2.000	2.500	3.000	3.500	4.000	
360HP													
360HP-15	1 1/2	490	CFM	5939	4709								
			BHP	1.12	1.12								
			Sones	16.1	15.8								
		545	CFM	7012	6115	4672							
			BHP	1.51	1.55	1.51							
			Sones	17.6	16.9	16.9							
360HP-20	2	600	CFM	8000	7272	6410	4868						
			BHP	1.97	2.06	2.09	1.99						
			Sones	18.4	17.6	17.3	17.4						
360HP-30	3	644	CFM	8745	8143	7381	6424	4630					
			BHP	2.40	2.52	2.55	2.57	2.37					
			Sones	19.0	18.3	17.7	17.7	18.1					
		687	CFM	9463	8955	8277	7528	6453					
			BHP	2.87	3.01	3.09	3.12	3.08					
			Sones	19.5	19.0	18.4	18.2	18.2					
360HP-50	5	730	CFM	10177	9716	9142	8465	7741	4517				
			BHP	3.41	3.56	3.68	3.71	3.77	3.28				
			Sones	20	19.7	19.2	18.6	18.6	20				
		815	CFM	11576	11150	10740	10198	9593	8138	4978			
			BHP	4.63	4.83	4.99	5.13	5.16	5.20	4.55			
			Sones	21	21	21	20	20	19.9	22			
360HP-75	7 1/2	874	CFM	12535	12131	11747	11319	10801	9633	7849			
			BHP	5.64	5.88	6.05	6.22	6.35	6.42	6.29			
			Sones	24	23	23	22	22	22	22			
		933	CFM	13487	13108	12740	12382	11939	10909	9748	7674		
			BHP	6.80	7.04	7.26	7.45	7.61	7.75	7.86	7.52		
			Sones	27	27	25	25	25	24	24	25		
360HP-100	10	980	CFM	14241	13880	13523	13182	12822	11879	10833	9417	6847	
			BHP	7.83	8.08	8.33	8.53	8.72	8.96	9.05	8.99	8.27	
			Sones	30	30	28	27	27	27	26	27	28	
		1026	CFM	14975	14631	14286	13957	13631	12806	11838	10796	8982	5679
			BHP	8.93	9.20	9.47	9.69	9.89	10.25	10.31	10.46	10.12	8.60
			Sones	33	34	32	30	29	30	29	29	30	32

MAX Bhp AT A GIVEN RPM = (rpm/469)³
 MAXIMUM RPM = 1026
 TIP SPEED (ft/min) = rpm x 9.424
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.0632 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).

The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

BSQ 420 - Belt Drive



Damper size = 54 x 54 (1372 x 1372)
 Unit weight** = 789 (358)
 Housing thickness = 14 ga

Dimensions shown in inches (millimeters) and weight is shown in pounds (kilograms).
 *Motor cover is optional. Size may be greater depending on motor.
 **Weight shown is largest cataloged Open Drip Proof motor.

Model Number	Motor HP	Fan RPM	CFM / Static Pressure in Inches wg										
			0.125	0.250	0.375	0.500	0.750	1.000	1.250	1.500	1.750	2.000	
420													
420-20	2	270	CFM	9901	8281								
			BHP	0.68	0.70								
			Sones	6.0	3.3								
		349	CFM	13501	12428	11210	9592						
			BHP	1.41	1.48	1.51	1.49						
			Sones	9.4	8.7	8.1	7.8						
		389	CFM	15275	14340	13334	12132						
			BHP	1.93	2.02	2.08	2.09						
			Sones	13.2	12.3	11.5	10.8						
420-30	3	417	CFM	16500	15633	14714	13745	11026					
			BHP	2.37	2.46	2.53	2.58	2.52					
			Sones	16.6	15.7	14.8	13.9	12.5					
		445	CFM	17704	16910	16068	15188	12941					
			BHP	2.86	2.96	3.05	3.11	3.12					
			Sones	20	19.5	18.6	17.7	15.9					
420-50	5	487	CFM	19500	18801	18054	17257	15475	13113				
			BHP	3.71	3.84	3.95	4.02	4.11	4.03				
			Sones	22	21	21	19.8	18.2	16.9				
		528	CFM	21244	20625	19937	19231	17747	15850	13154			
			BHP	4.70	4.85	4.97	5.08	5.22	5.24	4.99			
			Sones	25	24	23	23	21	20	18.7			
420-75	7 1/2	566	CFM	22854	22301	21659	21017	19644	18080	16134	13026		
			BHP	5.76	5.94	6.07	6.19	6.36	6.46	6.39	5.95		
			Sones	28	27	26	25	24	24	22	21		
		604	CFM	24459	23950	23363	22762	21502	20206	18533	16581		
			BHP	6.98	7.17	7.32	7.45	7.66	7.83	7.84	7.71		
			Sones	31	30	30	29	28	27	26	25		
420-100	10	635	CFM	25765	25281	24743	24171	22996	21762	20341	18681	16692	
			BHP	8.09	8.29	8.46	8.60	8.85	9.03	9.12	9.09	8.88	
			Sones	35	33	33	32	31	30	30	29	28	
		670	CFM	27237	26778	26291	25749	24660	23491	22322	20793	19111	16873
			BHP	9.47	9.69	9.88	10.03	10.33	10.52	10.71	10.70	10.61	10.24
			Sones	39	37	36	36	34	34	34	33	32	31

MAX Bhp AT A GIVEN RPM = (rpm/304)³
 MAXIMUM RPM = 670
 TIP SPEED (ft/min) = rpm x 11.060
 MAX NEMA MOTOR FRAME SIZE = 215T
 OUTLET VELOCITY (ft/min) = 0.0496 x cfm

Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (Bhp) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories).
 The sound ratings shown are loudness values in fan sones at 1.5 m (5 feet) in a hemispherical free field calculated per AMCA International Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels.

Direct Drive Specifications

Model SQ



Duct mounted supply, exhaust or return fans shall be of the centrifugal, direct-driven, inline type. The fan housing shall be of a square design constructed of heavy-gauge galvanized steel or aluminum and shall include square duct mounting collars.



Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

The fan wheel shall be centrifugal, backward-inclined, constructed of aluminum, and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

Motors shall be permanently lubricated and carefully matched to the fan loads. Motors shall be readily accessible for maintenance.

A NEMA-1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.

All fans shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

Fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

Fan shall be model SQ as manufactured by Greenheck Fan Corporation of Schofield, Wisconsin, USA.

Vari-Green® Motor

Motor to be an electronic commutation (EC) motor specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.



Vari-Green® Controls

Constant Pressure

Greenheck's Constant Pressure system shall be a complete package designed to regulate fan speed based on demand while maintaining a constant static pressure. System shall include fan with Vari-Green Motor, Vari-Green Constant Pressure control, transformer, and pressure tap. Vari-Green Constant Pressure control shall have the transducer integrated with a touch button control panel. Control shall have a run mode and a program mode preventing unwanted changes when in run mode. Transformer shall be factory-supplied to provide power to the Vari-Green Constant Pressure controller. System shall include a self-sealing aluminum pressure tube with ¼-inch connection. Fan shall be centrifugal direct drive type in upblast, downblast, or inline configuration with controllable EC Vari-Green motor.

Remote Dial

Remote dial shall be a Vari-Green control specifically designed to provide 0-10 VDC signal to Greenheck's Vari-Green Motor.

2-Speed

2-Speed control shall be a Vari-Green Control specifically designed to allow the Vari-Green Motor to operate at two distinct speeds. 2-Speed Control shall include two dials that may be set at any point between 0 and 10 VDC and an integral transformer capable of reducing 115/230 volt AC power to 24 volt AC power.

LEED information

Greenheck became one of the first manufacturers in the Air Movement and Control industry to join the LEED/green movement when they joined the United States Green Building Council (USGBC) in 2005. Greenheck has been actively researching qualification requirements for our products to meet LEED credits and prerequisites.



The Vari-Green® motor significantly helps qualification efforts for the Energy and Atmosphere credits and prerequisites; specifically credit one, Optimize Energy Performance and prerequisite two, Minimum Energy Performance.

Belt Drive Specifications

Model BSQ

Duct mounted supply, exhaust or return fans shall be of the centrifugal, belt-driven, inline type. The fan housing shall be of a square design constructed of heavy-gauge galvanized steel or aluminum and shall include square duct mounting collars.

Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

The fan wheel shall be centrifugal backward-inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

Motors shall be heavy-duty ball bearing type carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.

Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum L_{10} life in excess of 100,000 hours (L_{50} average life in excess of 500,000 hours) at maximum cataloged operating speed.

Drives shall be sized for a minimum of 150 percent of driven horsepower.

Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

A NEMA-1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.

Fan shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

Fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

Fan shall be model BSQ as manufactured by Greenheck Fan Corporation of Schofield, Wisconsin, USA.



Quick Delivery and Quick Build Programs

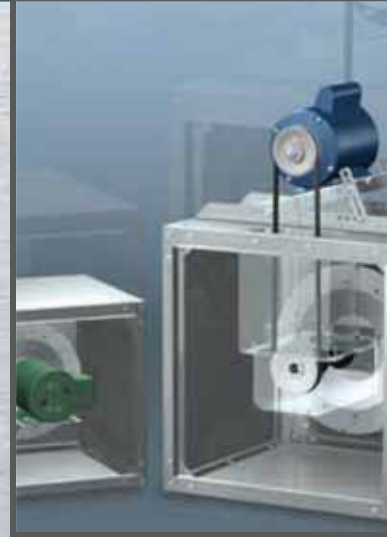


Greenheck Fan Corporation offers an extensive selection of Quick Delivery (QD) and Quick Build (QB) offerings. The QD program is Greenheck's stock program and the QB program offers configurable fans in one, three, five, or ten days.

Hundreds of in stock ventilation products and accessories are available for shipment to your jobsite in less than 24 hours from our strategically located warehouses throughout the world.

The Greenheck Stock and Quick Build catalog is a great resource for specific options and accessories available with QD and QB fans.

Model	Best Available Program
SQ-75 through 120 and 140	In Stock
BSQ-70 through 120, 140 through 180 and 240	
SQ-60 through 70, 130 and 160	1 Day
BSQ-130 and 200	
High Pressure BSQ-130HP through 240HP	3 Days
BSQ-300 through 420	
High Pressure BSQ-300HP and 360HP	



Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.



Prepared to Support Green Building Efforts



SECTION 23 0500

GENERAL MECHANICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Conditions, Supplemental Conditions, and the requirements of this Section apply to all work of Division 23.

1.2 QUALITY ASSURANCE

- A. Regulatory compliance: All work performed under Division 23 shall comply with the latest currently adopted editions of all codes and regulations and all requirements of all Authorities having Jurisdiction. The following references and standards are hereby made a part of these sections and work shall conform to applicable requirements herein, except as otherwise specified herein or shown on the Drawings.
- B. Codes, Standards: Conform to all applicable codes and standards as stated herein and as described in Division 01 of the Specifications, including the following:
1. American Gas Association (AGA)
 2. American National Standards Institute (ANSI)
 3. American Society of Mechanical Engineers (ASME)
 4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards 55 and 62.1
 5. American Society for Testing and Materials (ASTM)
 6. California Building Code (CBC)
 7. California Code of Regulations Titles 8, 17, 19, 20, 21 & 22
 8. California Electric Code (CEC)
 9. California Energy Conservation Code (Title 24)
 10. California Fire Code (CFC)
 11. California Mechanical Code (CMC)
 12. CAL Green Building Standards
 13. California Plumbing Code (CPC)
 14. City Fire Marshal requirements
 15. National Electrical Manufacturers Association (NEMA)
 16. National Fire Protection Association (NFPA)
 17. Office of Statewide Health Planning and Development (OSHPD)
 18. Sheet Metal and Air Conditioning Contractors Nation Association (SMACNA) Standards
 19. Underwriters Laboratories (UL)
 20. Comply with all ADA requirements for disabled access.
- C. Minimum requirements: The requirements of these are the minimum that will be allowed unless such requirements are exceeded by applicable codes or regulations, in which the regulatory codes or regulation requirements shall govern.
- D. When the Contract Documents call for materials or construction of a higher standard than is required by the above, the Contract Document requirements shall take precedence over the requirements of the said laws, rules, and/or regulations, accepting that nothing in the Contract Documents shall be interpreted as permitting work in violation of said laws, rules, and/or regulations. The Contractor for this work shall furnish any additional materials and/or labor as may be required for compliance with these laws, rules, and/or regulations though such materials

and/or labor are not specifically set forth in the Contract Documents, with no additional charges to Owner.

- E. Seismic construction and restraints shall be in accordance with the requirements of Title 17 and Title 24 of the California Code of Regulations. All equipment mounts, isolators, and hanging systems must meet local authority approval requirements.
- F. Comply with the Safety Orders issued by Cal-OSHA and any other regulations of the State of California and any districts having jurisdictional authority.

1.3 LICENSES, PERMITS, FEES

- A. The Contractors for the work of Division 23 shall provide, procure and pay for all licenses, permits, fees, etc. as required to carry on and complete their work.

1.4 LICENSING REQUIREMENTS

- A. All work of Division 23 shall be performed by an appropriately licensed contractor. The licenses shall be current, valid through the term of the contract and in the name of the contractor.
 - 1. All HVAC work, which includes warm air heating systems and water heating pumps, ventilating systems, air conditioning systems, and ductwork, registers, flues, humidity, and thermostatic controls in connection with these systems, shall be performed by a C-20 - Warm-Air Heating, Ventilating and Air-Conditioning Contractor.

1.5 CONTRACT DRAWINGS

- A. The Contract Drawings indicate diagrammatically the general layout of the mechanical systems and other related work. Field verification of scaled dimensions taken from the Drawings is required.
- B. Contractor shall review and compare the Structural, Plumbing, Mechanical and Electrical Drawings and all Owner supplied equipment Drawings and adjust their work to be in conformity with the conditions indicated thereon. Discrepancies between different Drawings, between Drawings and actual field conditions, or between Drawings and Specifications, shall promptly be brought to the attention of the Architect for a determination of the modifications to be affected.

1.6 SUBMITTALS

- A. General:
 - 1. All submittals shall be in accordance with the requirements of the General Conditions and Division 01 Sections for Submittal Procedures and Product Requirements.
 - 2. Before any fixtures, materials, or equipment are purchased, the Contractor shall submit to the Architect for approval, a complete list of materials, fixtures, and equipment, giving the manufacturers' names, catalog number, capacity, size, power requirements, and other pertinent data. Submittal lists and drawings shall be specifically applicable to this project, shall include identifying marks assigned by Specifications and Drawings, and shall not contain extraneous material or optional choices.
 - 3. The Contractor shall submit for the approval of the Architect, shop drawings of proposed material and equipment that differ from the specified materials and equipment, and of any specified materials and equipment with special conditions and/or arrangements. These drawings shall show necessary modifications of Owner, plumbing, electrical and mechanical work required by the proposed materials and equipment.
 - 4. Submittal of substitutions shall be limited to one proposal for each type or kind of item. If the first proposed product submittal is rejected, the Contractor shall then submit the first named or scheduled product.

5. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Drawings and Specifications but will indicate that the material submitted is acceptable in quality and utility. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other work.

1.7 WARRANTIES

- A. Equipment warranties shall be provided for all equipment, with all necessary information filled in, except purchase date, in favor of the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall be responsible for delivery, storage, protection and placing of all equipment and materials.
- B. Contractor shall protect the work and materials from damage during construction. Equipment stored at the jobsite shall be protected from dust, water or other damage, and be covered if equipment is exposed to weather. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
- C. Any items damaged shall be repaired or replaced, at no additional cost to the Owner.
- D. Cleanliness of Piping and Equipment Systems:
 1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 2. Piping systems shall be flushed, blown or pigged, as necessary, to deliver clean systems.
 3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.9 COOPERATION WITH OTHER TRADES

- A. Cooperate fully with other trades doing work on the project as may be necessary for the proper completion of the project. Refer to the Structural, Plumbing, and Electrical Drawings for details of the building structure and equipment installation that will tend to overlap, conflict with, or require coordination with the work of Division 23, and schedule this work accordingly.
- B. Priority of right of way in space shall be as follows, in decreasing order of authority:
 1. Electrical lights, electrical panels and drain piping.
 2. Ductwork.
 3. Fire protection piping, domestic hot water, domestic cold water and condenser water piping.
- C. Any work done without regard for other trades shall be moved, replaced, or redone as required, without extra charges to Owner.

1.10 ACCURACY OF DATA

- A. The data given herein and on the Drawings is as exact as could be reasonably secured, but absolute accuracy is not guaranteed. Exact locations, distances, elevations, etc. will be governed by shop drawings, the building itself, and actual field conditions.

1.11 UTILITY CONNECTIONS

- A. Arrange for all utility connections, determine their exact requirements, and pay all costs incurred.
- B. Send proper notices, make necessary arrangements, and perform other services required for care and maintenance of all utilities and assume all responsibility concerning same. Observe all rules and regulations of the respective utilities in executing the work.

1.12 DAMAGE BY LEAKS

- A. Contractor shall be responsible for any damage to work of other Contractors that is caused by leaks in any temporary or permanent piping systems due to pipe rupture, disconnected pipes or fittings, or by overflow of equipment.
- B. Patching and replacing of damaged work shall be done by the Contractor who installed the work, as directed by the Architect, but the cost of same shall be paid by the Contractor who is responsible for the damage.

1.13 REVIEW AND OBSERVATION

- A. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground system installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. After major equipment is installed.
 - 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- B. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Pre-closeout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer upon Engineer's acceptance that the mechanical systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

PART 2 - - PRODUCTS

2.1 PRODUCTS CRITERIA

- A. All materials, appliances, and equipment shall be new and best of their respective kinds, free from defects, and of the make, brand or quality specified or as accepted by the Architect.
- B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- C. Apply and install all items in accordance with the manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Architect for resolution.
- D. All fixtures, materials, and equipment equal in quality and utility to these herein mentioned will be accepted. When specific names are used in describing fixtures, materials, and equipment they are mentioned as standards only, but this implies no right on the part of the Contractor to use other fixtures, materials and equipment, or methods, unless approved as equal in quality

and utility by the Architect. The decision of the Architect shall govern as to what fixtures, materials, and equipment are equals to those mentioned, but the burden of proof as to the quality of any proposed fixtures, materials, or equipment shall be upon the Contractor. If any tests are necessary to determine the quality of proposed fixtures, materials, or equipment, an unbiased laboratory satisfactory to the Architect shall make such tests at the expense of the Contractor

2.2 HANGERS, SUPPORTS

A. Piping

1. Pipe supports shall be manufactured by Thomas & Betts, "Superstrut" or equivalent Cooper B-Line / Tolco or Anvil.
2. All hangers shall be electro-chromate finished. Hanger rods shall have electro-galvanized finish.
3. Copper tubing:
 - a. C-711 copper tube hanger, complete with C-716 isolator.
 - b. Copper pipe shall be attached to channels with A-716 "Cush-A-Clamp".
4. Trapeze hangers:
 - a. Grouped pipes may be supported by A-1200 channel bolted to rods.
5. Point of support connectors:
 - a. Wood construction:
 - 1) Stationary pipes: 540 side beam hangers
 - 2) Pipes subject to movement: S541
 - b. New concrete construction: 452 inserts.
 - c. Existing concrete construction: Phillips "Red-Head" 3-piece concrete anchors or Hilti "Quik-Bolt", drilled-in, concrete anchors.
 - d. Steel beams: Series 500 beam brackets.
 - e. Plywood decks: machine bolts, nuts and washers.
6. Vertical pipe risers:
 - a. Vertical pipe risers shall be securely supported with C-720 pipe clamps anchored to construction.
 - b. C-720P for bare cold-water pipe, anchored to construction.
7. Insulated pipe supports: K.B. Enterprises "Snapp Itz".
8. Pipes through studs or joists shall be isolated from structure with properly sized Hubbard "Hold-Rite" suspension clamps or LSP "Acousto-Plumb" system.

B. Ductwork

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
4. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
5. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
6. Trapeze and Riser Supports:
 - a. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - b. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - c. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.3 PIPING, DUCTWORK AND EQUIPMENT IDENTIFICATION

- A. Brady, Seton, Brimar, Craftmark, Champion America or approved equal identification products.

- B. Pipe Markers:
1. Plastic tape pipe markers. Flexible vinyl film tape with pressure sensitive adhesive backing and printed markings. Color-coded with lettering indicating service and arrow showing flow direction. Include identification of piping service using same designations or abbreviations as used on Drawings and indicate pipe size. All piping shall be identified.
- C. Pipe Label Color Schedule: (per ANSI A13.1 / ASME A13.1-2015)
1. Potable, Cooling, Boiler Feed and Other Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 2. Fire Quenching Fluids:
 - a. Background Color: Red.
 - b. Letter Color: White.
 3. Toxic or Corrosive Fluids:
 - a. Background Color: Orange.
 - b. Letter Color: Black
 4. Flammable or Oxidizing Fluids:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 5. Combustible Fluids:
 - a. Background Color: Brown.
 - b. Letter Color: White
 6. Compressed Air:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 7. Toxic and Corrosive Fluids:
 - a. Background Color: Orange.
 - b. Letter Color: Black
 8. Flammable or Oxidizing Fluids:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 9. Combustible Fluids:
 - a. Background Color: Brown.
 - b. Letter Color: White
- D. Stencils:
1. Stencil and Label Sizes (per ANSI A13.1 / ASME A13.1-2015 Standards):
 2. With clean cut symbols and letters of following size:
 - a. For pipes or covering with outside diameter $\frac{3}{4}$ to $1\frac{1}{4}$ inch, minimum length of label: 8 inches, minimum height of letters: $\frac{1}{2}$ inch.
 - b. For pipes or covering with outside diameter $1\frac{1}{2}$ to 2 inches, minimum length of label: 8 inches, minimum height of letters: $\frac{3}{4}$ inch.
 - c. For pipes or covering with outside diameter $2\frac{1}{2}$ to 6 inches, minimum length of label: 12 inches, minimum height of letters: $1\frac{1}{4}$ inch.
 3. Stencil Paint: As specified in Division 9, Finishes, semi-gloss enamel, colors conforming to ASME A13.1.
- E. Ceiling Tags: Steel with $\frac{3}{4}$ " diameter color coded head.
1. Color code as follows:
 - a. Yellow - HVAC equipment.
 - b. Red - Fire dampers/smoke dampers.
 - c. Blue - Heating/cooling valves.
 - d. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.
- F. Plastic Nameplates

1. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8" thick material.
 - a. Letter Color: White.
 - b. Letter Height: 1/2-inch.
 - c. Background Color: Black.
 - d. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 - e. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
- G. Tags
 1. For identification and Owner's maintenance records, all valves shall be numbered and identified with clearly stamped tags in accordance with drawings and service performed.
 2. Plastic Tags: Laminated 3-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2" diameter.
 3. Metal Tags: Polished Brass with stamped letters; tag size minimum 2" diameter with smooth edges.
 4. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
 5. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
 6. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- H. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7-inches.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Color: Yellow background with black lettering.
- I. Valves
 1. For identification and Owner's maintenance records, all valves shall be numbered and identified with clearly stamped 1¼" diameter brass tags, in accordance with drawings and service performed.
 2. Control valves shall be also marked whether normally open (N.O.) or normally closed (N.S.).
- J. Equipment
 1. All equipment shall be labeled with 1" high stencils showing identifying mark noted on drawings, and usage.
 2. Warning signs shall be placed on machines driven by electrical motors that are controlled by fully automatic starters, per California Code of Regulations, Title 8, Subchapter 7 - General Industry Safety Orders, Article 7, Section 3320.
- K. A typewritten schedule of all stencils and valve tags used, with identification, shall be framed and posted in mechanical rooms, at locations as directed.
- L. Detectable Underground Tape
 1. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape with aluminum backing, minimum 6-inches wide by 4 mil thick, manufactured for direct

burial service. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.4 ELECTRICAL MOTORS

- A. With exception of motors in AGA or UL labeled equipment, motors for HVAC blowers and fans, pumps, and other general-purpose applications using an adjustable speed drive shall be Baldor Premium Efficient Super-E®, three phase, foot mounted, Class H insulated motor with AEGIS shaft grounding ring installed internally, re-greasable ball bearings, dynamically balanced rotors.
- B. Motors shall be certified for quiet operation and shall bear a label so stating. Motors shall be drip-proof frame, 1.15 minimum service factor in 40°C, ambient windings specially impregnated and epoxy coated for outdoor service.
- C. Torque characteristics of motors shall be as required to accelerate machine to 100% full load speed within 10 seconds. Motors shall be dynamically balanced to maximum deflection as follows:
 - 1. 15 HP and larger: 0.0003 inches.
 - 2. 10 HP and smaller: 0.0002 inches.
- D. Motors shall be Inverter duty, meet NEMA MG-1 and part 30 and 31, and shall be guaranteed to satisfactorily operate at ± 10% voltage shown on Drawings. Transformers of adequate capacity shall be provided if necessary to satisfy this requirement.
- E. All 3-phase motors shall be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage or the voltage is more than 10% under design voltage.
- F. Fractional horsepower fan motors ($\frac{1}{4}$ hp, $\frac{1}{2}$ hp, $\frac{3}{4}$ hp) shall be Greenheck Vari-Green series motors, DC electronic commutation type, specifically designed for fan applications. Motors shall be permanently lubricated with heavy duty ball bearings to match the fan load and pre-wired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.
- G. Provide fan drives rated at 150% of motor horsepower. Drives shall be adjustable sheave type unless specified otherwise. Listed fan speeds are only approximate; select and/or change drives to operate at approximately midpoint of adjustable range after final balancing.

PART 3 - - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- B. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- C. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.

- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.2 DEMONSTRATION

- A. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.3 ACCEPTANCE

- A. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - 1. Testing and Balancing Reports
 - 2. Cleaning
 - 3. Operation and Maintenance Manuals
 - 4. Training of Operating Personnel
 - 5. Record Drawings
 - 6. Warranty and Guaranty Certificates
 - 7. Start-up/Test Document
 - 8. Commissioning Reports

3.4 IDENTIFICATION OF SYSTEMS (DISTRICT STANDARDS)

- A. General
 - 1. Identify air handling units and heat transfer equipment with plastic nameplates riveted to equipment body.
 - 2. Identify ductwork with plastic ductmarkers.
 - 3. Identify piping, concealed or exposed, with stencilled painting.
 - 4. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 - 5. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
 - 6. Degrease and clean surfaces to receive adhesive for identification materials.
 - 7. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
 - 8. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
 - 9. Install all products in accordance with manufacturer's instructions.

10. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.
 11. Refrigerant piping shall be identified. All equipment having an internal volume of more than 3 cubic feet shall be labeled with the type of refrigerant contained in the vessel.
 12. Identify and label all piping crossing through wall(s), within 3 feet of the entry and on both sides of the wall.
- B. Plastic Nameplates
1. Install plastic nameplates with corrosive-resistant mechanical fasteners.
 2. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
 3. Identify thermostats with nameplates.
 4. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- C. Tags
1. Use metal tags on piping 3/4-inch diameter and smaller.
 2. Tag balancing valves and major dampers with balanced GPM or CFM indicated after balancing is completed and accepted.
 3. Install tags with corrosion resistant chain.
 4. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
 5. Identify air terminal units and radiator valves with numbered plastic tags.
 6. Tag automatic controls, instruments, and relays. Key to control schematic.
 7. Install valve schedule at each mechanical room.
- D. Plastic Pipe Markers
1. Install plastic pipe markers complete around pipe in accordance with manufacturer's instructions.
 2. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.
- E. Ceiling Tags
1. Provide ceiling tags to locate valves, dampers, and equipment above accessible ceilings. Locate in corner of ceiling tee grid closest to equipment.
- F. Detectable Underground Tape
1. For underground piping installations, Install underground plastic pipe markers with tracer wire 6- inches to 8-inches below finished grade, directly above buried pipe.
- G. Stencils
1. Prepare surfaces for stencil painting.
 2. Follow manufacturer's instructions for paint used for stencils.
- H. Piping
1. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - a. Adjacent to all valves and flanges
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

- c. At both sides of wall, or floor penetrations.
 - d. Near penetrations through ceilings, and inaccessible enclosures.
 - e. Adjacent to changes in direction.
 - f. At access doors, manholes, and similar access points that permit view of concealed piping.
 - g. Near major equipment items and other points of origination and termination.
 - h. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - i. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- I. Valves:
- 1. Control valves shall be also marked weather normally open (N.O.) or normally closed (N.S.)

3.5 CUTTING AND PATCHING

- A. Additional openings required in building construction to be made by drilling or cutting. Provide all necessary cutting in connection with the work of this Section. No cutting shall be done without the approval of the Architect. NO structural members shall be drilled, bored, or notched in a manner that will impair their structural capacity. All penetrations of concrete or masonry shall be made with core drills. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
- B. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
- C. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
- D. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT

- A. Equipment shall operate quietly and without objectionable vibration. Such problems, other than from equipment operating at optimum conditions, shall be the Contractor's responsibility and shall be eliminated at the direction of the Architect.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.
- C. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner. Install equipment to provide good appearance, easy access, and adequate space to allow replacement and maintenance. Provide bases, supports, anchor bolts, and other items required to achieve this. Installation shall be level, above moisture level, and adequately braced.

- D. Extend 1/4" schedule 40 black steel lubrication pipes from hard-to-reach locations to front of equipment or to access doors. Terminate with proper lubrication fittings.
- E. Move equipment into building through available openings. Dismantle equipment where necessary to accomplish this. After reassembly, test equipment to verify its satisfactory operating condition.
- F. Thoroughly lubricate equipment before operating. Repair of damage resulting from failure to comply with this requirement shall be the Contractor's responsibility.
- G. Connections to piping shall be secured and properly aligned and all utility and control connections shall be properly isolated from the building structure by means of vibration isolators and flexible connections. Any equipment not meeting this requirement will be modified and properly reinstalled at no expense to the Owner.

3.7 SEISMIC FORCE RESISTANCE

A. Equipment:

- 1. Each piece of equipment installed under this Section shall be constructed and anchored to structural supports to resist a seismic force of 150% of the equipment's operating weight in any direction. Supports, anchors, and braces shown shall be minimum.
- 2. Equipment manufacturer shall design, construct, and certify that his equipment satisfies the special minimum seismic resistance requirements and shall submit calculations or test results supporting his certification.

B. Piping:

- 1. Flexibility of piping systems must be maintained by the use of flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.
- 2. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4" and larger. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions
- 3. Sway bracing shall be installed at intervals of 30 to 40 feet on pipe runs to prevent excessive lateral motion. Bracing shall be designed to resist a force equal to 100% of the weight of piping system and contents, applied in any direction.
- 4. In design of the braces, the slenderness ratio l/r , shall not exceed 200 where "l" is the effective length of the brace and "r" is the least radius of gyration, both in inches. The following table shows maximum lengths of shapes used for sway bracing:

TYPE/SIZE	MAX. LENGTH	TYPE/SIZE	MAX. LENGTH
Angle	($l/r=200$)	Flat Bar	($l/r=200$)
1 1/2 x 1 1/2 x 1/4"	4'-10"	1 1/2 x 1/4"	1'-2"
2 x 2 x 1/4"	6'-6"	2 x 1/4"	1'-2"
2 1/2 x 2 1/2 x 1/4"	8'-2"	2 x 3/8"	1'-9"
3 x 3 x 1/4"	9'-10"		
Threaded Rod		Pipe (Schedule 40)	
3/8"	1'-7"	1"	7'-0"
1/2"	2'-1"	1 1/4"	9'-0"
5/8"	2'-7"	1 1/2"	10'-4"
3/4"	3'-1"	2"	13'-1"

1"

4'-2"

5. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
6. Equipment manufacturer shall construct and certify that his equipment satisfies the special minimum seismic resistance requirements.

C. Piping:

1. Flexibility of piping systems must be maintained by the use of flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.
2. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4" and larger.
3. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions.
4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.

3.8 ACCESS

- A. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include but are not limited to: all types of valves, filters and strainers, transmitters and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract Drawings to the Architect for resolution.

3.9 MECHANICAL SERVICES

- A. Terminals and services weighing no more than 20 pounds, may be supported directly on the runners of a heavy-duty grid system but, in addition, they must have a minimum of (2) #12 gage slack safety wires attached at diagonally opposite corners and anchored to the structure above.

3.10 CONCRETE EQUIPMENT BASES

- A. Concrete work that is part of the mechanical installations, as such is shown and/or detailed on the Drawings, shall conform to the requirements of the Concrete Section of these Specifications.
- B. Concrete bases: Anchor equipment to concrete base according to equipment details on mechanical and structural Drawings.
- C. Bases shall be neatly finished, have rounded corners and smooth trowel finish.

3.11 ELECTRICAL REQUIREMENTS

- A. Electrical work in this Section shall conform to the requirements of Division 26. Equipment shall conform to the standards of the National Electric Manufacturer's Association. Electrical equipment shall bear the label of Underwriters' Laboratories, Inc., where examination and listing service is available for such materials. Motors and motor control equipment shall be as specified below.
1. The work shall include the furnishing of:
 - a. Motor controls mounted as integral part of equipment assemblies.
 - b. Pre-wired control panels as described and shown.
 - c. Electronic control panels and their components.
 - d. Wiring for low voltage controls and "interlock work" except where specifically shown otherwise.
 2. Installing of:
 - a. All motors.
 - b. All control panels and their components.
 - c. Low voltage wiring, line voltage "interlock" wiring, control wiring for safety devices, alarms, and refrigeration.
- B. Wiring includes all connections to devices, and all wiring shall be installed in conduit.
1. Conduit fittings and devices shall be as specified in the basic electrical materials section of Division 26 - Electrical.
 2. Line voltage work (in equipment assemblies) shall be as specified in Division 26 - Electrical.
 3. Devices shall be installed in NEMA enclosures of type required for location.
- C. Electrical Controls:
1. Submit shop-wiring diagrams of temperature controls and air conditioning unit controls for approval. Furnish approved wiring diagrams and assistance to Electrician.
 2. Refer to Electrical, Fire Protection, Plumbing and Mechanical documents for work and devices required. All wiring required by plumbing and heating, ventilating and air conditioning work shall be performed by the Controls Contractor.
- D. The following work will be furnished and installed under Division 26 of these Specifications:
1. Disconnect switches, remote switches, motor starters, relays and test switches not mounted as integral part of equipment assemblies or in temperature control panels.
 2. All line voltage controls and interlocks, all other controls, circuits from electric panel board to disconnect switches, starters, motors, switches and/or other motor controls, to temperature controls and safety devices.

3.12 PAINTING

- A. Properly prepare work to be painted per the requirements of Division 09, except preservative and special painting as described herein. Priming shall conform to Division 09 requirements and be of a material compatible with paint for finish painting.
- B. Priming, as required, shall conform to the Painting section requirements and be of a material compatible with paint for finish painting.
- C. All equipment and materials shall be cleaned of grease, wax, oil, rust or dirt in preparation for finish painting. Any prime coated surfaces showing signs of rust before being finish painted shall be thoroughly cleaned and a new prime coat applied.
- D. Equipment in equipment rooms and like spaces, shall be furnished with a factory applied baked prime coat or at Contractor's option, a standard factory baked enamel finish in approved colors. Machinery such as fans, or motors shall be furnished with a factory applied baked on prime

coat, or at the Contractor's option, a standard paint finish (air dried or baked enamel) in approved colors. Mechanical equipment in other locations shall be furnished with a factory applied baked prime coat, unless noted otherwise.

- E. Paint interior of ductwork at air outlets with one coat of flat black paint.
- F. Prime paint both sides of flashings prior to installation.
- G. Furnish can of touch up paint with each factory finished piece of equipment.
- H. Paint all piping in mechanical rooms. Color as selected by the Architect.
- I. Black steel piping exposed to the environment shall be painted with rust-inhibiting paint. Color as selected by Architect.

3.13 INSTALLATION, HANGERS AND SUPPORTS

- A. Refrigerant piping shall be supported per CMC 1109.6.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- C. No valve or piece of equipment shall be used to support piping.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- E. Flexibility of piping systems must be maintained by the use of flexible devices at critical points at junctions of separate building structures. Braces or anchors shall be designed to damp oscillations or check excessive movement. Flexible devices for piping of gas shall be loops or offsets. Flexible devices for other piping may be loops, Victaulic grooved, or roustabout couplings.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Piping at tops and bottoms of risers are critical points where flexibility is required, as well as at changes in direction on long runs of piping 4" and larger.
- H. Tops of risers shall be restrained from motion in horizontal direction, and midpoints shall be anchored in all directions.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2-½ inches and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Metal Pipe-hanger Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- K. Metal Trapeze Pipe-Hanger Installation: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- L. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping operating above ambient air temperature: Clamp may project through insulation.
 - b. Piping operating below ambient air temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping

3.14 INSTALLATION HANGERS AND SUPPORTS - DUCTWORK

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.
- C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.15 PIPING & VALVE INSTALLATION

- A. Valves, cocks, etc., shall be installed to allow convenient accessibility and operation.
- B. Unions and flanges shall be installed to allow convenient replacement of all equipment and cleaning tubes.
- C. A union connection shall be installed downstream from all valves, at equipment connections and at other locations as required or directed.
- D. Shut off valves shall be provided in all main services, and where required to permit proper servicing of equipment. Valves of one type shall be of one manufacturer.
- E. All valves shall be of the same size as the pipelines in which they are installed, unless specifically sized on the Drawings. All hand-controlled line valves shall be ball valves, except where throttling control or frequent operation is required, in which case globe or angle valves shall be used. Globe valves in horizontal lines shall be installed with stem in horizontal to permit line draining. All globe and angle valves shall be installed to close against pressure. Disc valves shall have discs suitable for the services for which they are to be used.
- F. All valves shall be accessible and shall not be installed with the stems below the horizontal plane. Provide access panels at walls, ceilings, or floors.
- G. Provide prime coated escutcheon plates at all points where exposed piping penetrates finished wall ceilings or floors.
- H. Cutting or boring of joists or other structural members shall be done only when alternative routing is impossible and only upon written approval of the Architect or Owner.

3.16 CLEANUP

- A. Upon completion of the work, remove all material, debris, and equipment associated with or used in the performance of this work.

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems
 - 2. Additional Tests
 - a. Duct leakage testing
 - b. Controls verification

1.3 SCOPE

- A. The T&B Agency will provide the following services:
 - 1. Provide all supervision, personnel, instruments, calibration equipment, and all other materials necessary to perform balancing and testing, and compile test data including calculations and services necessary for the heating, ventilating, and air conditioning systems for this project, all in accordance with the project Drawings and Specifications and as specified herein.
 - 2. The T&B Agency shall be responsible for inspecting, balancing, adjusting, testing, and logging the data of the performance of fans, all dampers in the duct systems, all air distribution devices or heat exchangers, and the flows of water through all coils.
 - 3. The T&B Agency shall balance, test, and adjust the systemic components to obtain optimum conditions in each conditioned space in the building. If construction deficiencies are encountered which preclude obtaining optimum conditions, the deficiencies will be recorded and given to the Owner's Representative. The T&B Agency is advised that deficiencies in the HVAC construction are often encountered during final T&B services and should include in the bid an amount deemed advisable to compensate for time in identifying the deficiencies.
- B. During construction, the T&B Contractor shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of three times. Typically, this is performed when 60% of the ductwork and piping are installed and again when 90% of the total system is installed and prior to insulation. A copy of the written report is to be issued to the Mechanical Engineer for review.

1.4 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit T&B strategies and step-by-step procedures.
- B. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists for use by systems installers in verifying system readiness for T&B. Examination Report: Within 30 days of Contractor's Notice to Proceed, provide a summary

report of the examination review required in Part 3 "Examination", if issues are discovered that may preclude the proper testing and balancing of the systems.

- C. Examination Report: Provide a summary report of the examination review if issues are discovered that may preclude the proper testing and balancing of the systems.
- D. Certified T&B reports: Within 30 days of completion of balancing work, submit AABC-certified T&B report.
 - 1. Submit one copy of the final T&B Report directly to the design professional of record. Provide five additional copies to the contractor.

1.5 QUALITY ASSURANCE

- A. T&B Contractor Qualifications:
 - 1. General Contractor will employ a T&B Agency that is certified by the Associated Air Balancing Council (AABC). The T&B Agency will have experience in the field of air and hydronic system balancing, possess calibrated instruments, and employ qualified Supervisors and skilled Technicians to perform all required tests. The T&B Agency shall have a minimum of 10 years of experience in the Testing, Adjusting, and Balancing field.
- B. T&B technician shall perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified T&B reports.
 - 2. Certify that the T&B team complied with the approved T&B plan and the procedures specified and referenced in this Specification.
 - 3. Certify the T&B report
- C. T&B Conference: If requested by the Owner or Construction Manager after approval of the T&B Agency's submittals, meet to develop a mutual understanding of the details
 - 1. Agenda Items:
 - a. The examination report.
 - b. The Strategies and Procedures plan.
 - c. Systems readiness checklists.
 - d. Coordination and cooperation of trades and subcontractors.
 - e. Coordination of documentation and communication flow.
- D. Approved Test and Balance agencies in the area:

RS Analysis, Inc.
1035 Suncast Lane, Suite 130
El Dorado Hills, CA 95762
(916) 358-5672

National Air Balance Company, Inc.
4171 Business Center Drive
Fremont, CA 94538
(510) 623-7000

Raglen System Balance, Inc.
1121 University Terrace
Reno, NV 89502
(775) 747-0100

Pacific Test & Balance, Inc.
4771 Mangels Blvd.
Fairfield, CA 94534
(707) 696-2444

- E. T&B Report Forms: Use standard T&B contractor's forms.
- F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in "AABC National Standards for Total Systems Balance."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION & REVIEW

- A. Review the Contractor shop drawing submittals for their effect on the test and balance process and overall performance of the HVAC system. Submit recommendations for enhancements or changes to the system.
- B. Review location and type of volume damper inlet conditions to air terminals, air valves, and HVAC equipment.
- C. Review location, type, and size of balancing valves, flow metering stations, and automatic control valves in the water flow station.
- D. Review location of pressure sensors in the air and water distribution system.
- E. Review automatic control systems as they affect the test and balance procedure.
- F. Review sheet metal and piping shop drawings to verify the installation of flow control devices.
- G. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.
- H. Review the approved submittals for HVAC systems and equipment.
- I. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas.
- J. Review equipment performance data including fan and pump curves.
- K. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and controls are ready for operation.
- L. Examine terminal units such as variable-air-volume boxes and verify that they are accessible and their controls are connected, configured by the Controls Contractor, and functioning.
- M. Examine strainers to verify that Mechanical Contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.
- N. Examine two-way valves for proper installation and function.
- O. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- P. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

- Q. Examine air vents to verify that Mechanical Contractor has removed all air from all hydronic systems.

3.2 PREPARATION

- A. Prepare a T&B plan that includes:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checklists, as described in the *AABC National Standards for Total System Balance*, for use by Contractors in verifying system readiness for T&B. These shall include, at a minimum:
 - 1. Airside:
 - a. All ductwork is complete with all terminals installed.
 - b. All volume, smoke and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. All fans are operating, free of vibration, and rotating in correct direction.
 - e. VFD start-up is complete and all safeties are verified.
 - f. Automatic temperature-control systems are operational.
 - g. Ceilings are installed.
 - h. Windows and doors are installed.
 - i. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for T&B procedures.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.

- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling-unit components.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 - 3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust sub-main and branch duct volume dampers for specified airflow. Re-measure each sub-main and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure airflow at all inlets and outlets.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after all have been adjusted.
- D. Verify final system conditions.
 - 1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm total airflow is within design.
 - 3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
 - 4. Mark all final settings.
 - 5. Test system in economizer mode. Verify proper operation and adjust, if necessary.
 - 6. Measure and record all operating data.
- E. Record final fan-performance data

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located $\frac{2}{3}$ of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows
 - a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
 - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify all terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

- b. Re-measure and confirm total airflow is within design.
- c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
- d. Mark all final settings.
- e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
- f. Verify tracking between supply and return fans.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

3.8 TOLERANCES

1. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - a. Supply, Return, and Exhaust Fans and Equipment with Fans: +/- 10%.
 - b. Air Outlets and Inlets: +/- 10%.
 - c. Heating-Water Flow Rate: +/- 10%.
2. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.9 FINAL TEST AND BALANCE REPORT

- A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.
- B. The report must be organized by systems and shall include the following information as a minimum:
 1. Title Page:
 - a. AABC certified company name
 - b. Company address
 - c. Company telephone number
 - d. Project identification number
 - e. Location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project number
 - j. Date of report
 - k. AABC Certification Statement
 - l. Name, signature, and certification number of AABC TBE
 2. Table of Contents.
 3. AABC National Performance Guaranty.
 4. Report Summary:
 - a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
 5. Instrument List:
 - a. Type.
 - b. Manufacturer.
 - c. Model.
 - d. Serial Number.

- e. Calibration Date.
- 6. T&B Data:
 - a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards."
- C. One copy of the final test and balance report shall be sent directly to the Mechanical Engineer of record. Provide five additional copies to the contractor.

3.10 ADDITIONAL TESTS

A. Duct Leakage Test

1. All ductwork shall be tested for leaks, using necessary instruments before insulating any ductwork. Conduct test as follows and as recommended in SMACNA Balancing Manual.
 - a. Seal all openings in duct section and plenum to be tested.
 - b. Connect test apparatus to test section of cuts, using a flexible duct connection or hose (fitting provided by Mechanical Contractor).
 - c. Close damper on blower suction side, to prevent excessive build-up of pressure.
 - d. Start blower and gradually open damper on suction side of blower.
 - e. Determine amount of air leakage and make repairs as required.
 - f. Leakage factor allowable shall be 5% based on the total operating cfm of the section of duct under testing.
 - g. Tested sections of ductwork shall be visually marked with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.
2. Witness the duct pressure testing performed by the mechanical/installing contractor.
3. Verify that proper test methods are used and that leakage rates are within specified tolerances.
4. Report any deficiencies observed.

B. Controls Verification

1. In conjunction with system balancing perform the following:
 - a. Work with the temperature control contractor to ensure the system is operating within the design limitations and gain a mutual understanding of intended control performance.
 - b. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open position. This includes dampers in multi-zone units.
 - c. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
 - d. Verify the proper application of all normally open and normally closed valves.
 - e. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 - f. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures, humidities, or pressures. Control Contractor will relocate as deemed necessary by the TAB Agency.
 - g. Check the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that heating cannot take place until the cooling zone of valve is completely closed.
 - h. Verify that all controller set points meet the design intent.
 - i. Verify the operation of all interlock systems.
 - j. Verify that controllers are calibrated and function as intended.
 - k. Verify that controller setpoints are as specified.
 - l. Verify the operation of lockout or interlock systems.
 - m. Verify the operation of all valve and damper actuators.
 - n. Verify that all controlled devices are properly installed and connected to the correct controller.

- o. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
 - p. Perform all system verification to assure the safety of the system and its components.
 - 2. Reporting
 - a. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.
 - 3. A systematic check of the above requirements shall be included in the final TAB report.

3.11 FINAL ACCEPTANCE

- A. At the time of final inspection, the T&B Agency shall recheck, in the presence of the Owner's Representative, specific and random selections of data, i.e. water and air quantities, recorded in the Certified Report.
- B. Points and areas for recheck shall be selected by the Owner's Representative.
- C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.
- D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.
- E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to the Owner.
- F. Following final acceptance of the Certified Report by the Owner's Representative the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the T&B Agency, so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION

SECTION 23 0923

DIRECT DIGITAL CONTROLS SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish an Alerton BACnet Energy Management System (EMS) as specified herein to tie into and match the Owner's current Energy Management System Standard. No substitutions. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2016, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. The native BACnet EMS shall be as specified herein and consist of a high-speed, peer-to-peer local area network of DDC controllers connected to a dedicated Server PC and other client workstation PC's and Lap Top computers as specified. All HVAC and/or Electrical system points monitored and controlled by the EMS, including the building floor plans as well as all control devices, will be depicted by point-and-click graphics.
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. All controller devices must be BTL tested and listed by the official BACnet Testing Laboratory, having the BTL approval mark issued.
- D. All devices in this new project facility location shall be accessible from a single graphical user interface.
- E. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- F. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- G. Furnish and install the required software to produce a complete and operational native BACnet EMS as specified herein.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists, including a dedicated project manager, and technicians throughout the duration of the project to assist in all phases of EMS system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

1.2 SYSTEM DESCRIPTION

- A. A distributed logic control system by Alerton complete with all software and hardware functions shall be provided and installed. This system is to control all mechanical equipment, including all unitary equipment such as heat pumps, fan- coils, AC units, etc., and all air handlers, boilers, cooling towers, and any other listed equipment using native BACnet-compliant components. Non-BACnet- compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. System shall be interfaced to existing District Alerton Compass Server.
- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- D. All application controllers for every terminal unit (HP, UV, etc.), air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable controllers as manufactured by Alerton. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.
- E. System Architecture
 - 1. EMS Contractor shall utilize Owner's IT WAN for connection from BACnet Server to all Global Controllers furnished and installed as part of this project. Owner shall furnish and maintain IT WAN infrastructure.
 - 2. EMS Contractor shall provide and install a dedicated MS/TP LAN extending from all Global Controller's to distributed field level controller BACnet devices.
 - 3. Distributed field level controllers are responsible for directly controlling and monitoring HVAC and Electrical system points throughout the facility.
 - 4. The BACnet Server hosts system configurations, programming databases and stores all trendlog data. The Server maintains all backup files for system configuration and programming located on Global Controller's and field level controllers and is capable of directly uploading or downloading information from the controllers.
 - 5. An operator's workstation and/or any designated portable operator's terminal (if specified) shall be used as a graphical user interface to provide system supervision, management report generation and alarm annunciation.

1.3 APPROVED MANUFACTURERS

- A. Approved Control Manufacturers:
 - 1. Alerton – Ascent Compass; no substitution – Contact Syserco: 510.498.1171 for further bid coordination.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of EMS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of EMS systems similar in size and complexity to this project.
- B. The EMS system shall be designed, installed, commissioned, and serviced by manufacturer-authorized and trained personnel. System provider shall have an in- place

support facility within 50 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.

- C. To provide the level of support and response required by the Owner, the Energy Management System Contractor shall have a fully staffed service department with the following minimum personnel and service offerings:
 - 1. Minimum of 1 (one) Dedicated Support Technician located at a fixed location with access to a network for remote access to the site.
 - 2. Minimum of 1 (one) Dedicated Service Dispatcher to route calls and prioritize service response.
 - 3. Minimum of 5 (five) Dedicated Field Service Technicians. To ensure that there are personnel available to respond to service requests in a timely manner, these technicians are to be dedicated to service and not used on construction projects.
 - 4. Maintain a 24/7 Service Call Center staffed by live operators enabling immediate response to Owner's critical emergency EMS concerns.
- D. The EMS Contractor shall provide an on-site, experienced project manager for this work who is responsible for direct supervision of the installation, start up and commissioning of the EMS system.
- E. EMS Contractor shall have a proven record of successful native BACnet installations and maintenance of equivalent native BACnet systems for a minimum period of 5 years utilizing the same native BACnet manufacturer's product line that the Contractor proposes to use on this project.
- F. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- G. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

1.5 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2016, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A.
 - 7. EMC Directive 89/336/EEC (European CE Mark).
 - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.6 SUBMITTALS

A. Drawings

1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
3. Eight (8) complete sets (copies) of submittal drawings shall be provided.
4. Drawings shall be available on CD-ROM.

B. System Documentation

1. Include the following in submittal package:
 - a. System configuration diagrams in simplified block format.
 - b. All input/output object listings and an alarm point summary listing.
 - c. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - d. Complete bill of materials, valve schedule and damper schedule.
 - e. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - f. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
 - g. For all system elements—operator's workstation(s), building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
 - h. Provide complete description and documentation of any proprietary (non- BACnet) services and/or objects used in the system.
 - i. A list of all functions available and a sample of function block programming that shall be part of delivered system.

1.7 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one (1) year from completion of system acceptance.
- B. Extended Warranty – Years 2 to 5. For Characterized Control Valves (CCV), Globe Valves, Butterfly Valves, associated Valve Actuators and Damper Actuators, provide like kind replacement components for any defective material identified and returned in Years 2 to 5 from the date of system acceptance.
- C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor.
- D. This warranty shall apply equally to both hardware and software. This warranty shall apply equally to both hardware and software.

1.8 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for related contractual requirements.
- B. Refer to Section 23 00 00 for General Mechanical Provisions.
- C. Refer to Section 26 00 00 for General Electrical Provisions.

PART 2 - PRODUCTS

2.1 ADVANCED WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database for the BACnet network as specified in these contract document Specifications and project Plan Drawings. Install one Workstation per Building at location designated by Chabot
1. Las Positas CCD representative.
- B. BACnet Conformance
1. Operator workstation shall be approved by the BTL as meeting the BACnet Advanced Workstation (AWS) requirements.
- C. Data Displays
1. Data displays shall render all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings.
 2. Data displays shall render all data using iconic graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user.
 3. Data display frame shall allow user to change all field-resident AWS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
 4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic.
 5. All displays and programming shall be generated and customized by the local EMS Contractor. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
 6. AWS shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. AWS shall include a library of equipment graphic components to assemble custom graphics. Systems that do not allow customization or creation of new graphic objects by the operator (or with third- party software) shall not be allowed.
 7. Data display frame shall include customizable and persistent tree navigation for building, equipment and system diagnostic centric display organization.
 8. Each display may be protected from viewing unless operator credentials have the appropriate access level. An access level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
 9. Data displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.
 10. Data displays shall support:
 - a. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables and range set points.
 - b. Clear and custom geometry navigation buttons to provide intuitive navigation.
 - c. Graphic files in jpg, png, and .gif file types.
 - d. Viewing of 1,024 system data points in a single screen.
 11. All graphical user interface screens developed for Thick or Web Client devices on this project shall be seamlessly integrated to the existing Alerton Ascent Compass Server PC

by the EMS Contractor. Graphical user interface screens for this project requiring software enabling/support beyond Alerton Ascent Compass are specifically prohibited.

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. AWS shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0–8 characters, User Name shall be 0–29 characters, and Password shall be 4–8 characters long.
3. Each user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to discrete BACnet devices to which that user requires access.
4. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal.
5. Users shall also have a set access level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct access levels for assignment to users.
6. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
7. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. Operator Activity Log that tracks all operator changes and activities shall be included with AWS. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.
2. Log shall be gathered and archived to hard drive on AWS as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

F. Scheduling

1. AWS and Web Client shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate access privileges.
4. AWS shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right- clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

6. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
7. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule allow the point to be scheduled.
9. Schedule editor shall support Drag-n-drop events and holidays onto the schedule calendar.
10. Schedule editor shall support Drag-n-drop events default to a 2hr period; which can then be adjusted by the user.
11. Schedule editor shall support Drag-n-drop holidays are defaulted for OFF all day and can be edited for multiple-day holidays.
12. Schedule editor shall support the View of affected zones when adding or editing timed events of a schedule.

G. Alarm Indication and Handling

1. AWS shall provide visual, printed, and email means of alarm indication. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level Web client shall display a persistent alarm state for the system regardless of the data view including points in alarm but not acknowledged, and points that have gone into alarm and returned to normal without being acknowledged.
2. Alarm History shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the AWS. Each entry shall include a description of the event- initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).
4. AWS shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull- down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
5. AWS shall support color-coded indication of current alarms as follows:
 - a. Red indicator shows number of active alarms that have not been acknowledged.
 - b. Yellow indicator shows number of alarms that are still active but have been acknowledged.
 - c. Blue indicator shows number of alarms that have returned to normal but have not been acknowledged.
 - d. Color-coded indicators, when selected by the user, navigate to a pre- filtered view of Alarm History.
 - e. Alarm history can be filtered by color-coded indicator states.
6. Alarm annunciation includes navigation link to a user selected display or URL.
7. User can silence audible annunciation for the current session.
8. User can disable auto-refresh of alarm annunciation for current session.
9. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or allow the creation of a new alarm.

H. Trendlog Information

1. AWS shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the web client. Operator shall be able to view all trended records, both stored and archived. All trendlog records shall be displayed in standard engineering units.
2. AWS shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. AWS shall be able to change Trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. All operations shall be password protected. Viewing may be accessed directly from any and all graphics on which a trended object is displayed.
4. AWS shall include a Trendlog Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.
5. AWS shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog view.
7. Trendlog viewer shall provide:
 - a. Software that is capable of graphing the trend logged object data shall be included.
 - b. Access and ability to create, edit and view are restricted to users by user account credentials
 - c. Specific and repeatable URL defines the trendlog(s) that comprise the view
 - d. Call out of trendlog value at intersection of trend line and mouse-over vertical axis.
 - e. Trend log and companion logs can be configured to display on one of two independent vertical scales.
 - f. Click zoom for control of data set viewed along either graph axis.
 - g. User specifiable start and end dates as well as a fast scroll features that that supports click zoom of macro scale view of the data for quickly finding data set based on visual signature.
 - h. User export of the viewed data set to MS Excel.
 - i. Web browser-based help
 - j. Optional min/max ranges (Upper Control Limits, Lower Control Limits) for each value.

I. I. Energy Log Information – As Scheduled

1. AWS shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. AWS Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. AWS shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

J. Reports

1. AWS shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
 2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.
- K. Configuration/Setup
1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.
- L. Field Engineering Tools
1. AWS shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
 2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
 3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
 4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
 5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
 6. AWS automatically notify the user when a device that is not in the database is added to the network.
 7. AWS shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
 8. The system shall provide a means to scan, detect, interrogate, and edit third- party BACnet devices and BACnet objects within those devices.
- M. Workstation Hardware – As Scheduled
1. Provide a minimum of one operator's workstation per building at location(s) noted on the plans or as coordinated by Chabot Las Positas CCD representative.
 2. Workstation Hardware
 - a. 64-bit OS.
 - b. Windows 10.
 - c. 2 GHz (or better), one or more dual-core or quad-core processors.
 - d. 8 GB RAM or higher.
 - e. 3 GB of hard drive space required for base installation without application data.
 - f. Network interface card (10/100/1000 Mbps).

2.2 CONTROL PROGRAMMING SOFTWARE

- A. All DDC programming throughout the EMS network shall adhere to the following standards:
 - 1. Programming on all controllers must be completely operator definable and modifiable and must use a single common programming language for all control devices. Use of pre-canned, factory burned-in DDC programming on controllers is not acceptable and is grounds for rejection of EMS system.
 - 2. Programming shall be developed in an object-oriented graphical programming environment. Line by line code programming is specifically prohibited and is not acceptable.
 - 3. Programming must accommodate all written sequences of operations.
 - 4. Programming shall be modifiable from any server PC, operator console PC and/or portable laptop PC workstation without requiring the burning of new chips or having to directly access the local controller. Software shall accommodate the downloading of programming via established network Ethernet or modem connections.
 - 5. Programming must support the use of virtual software points in the same manner as all physical points are supported.
 - 6. All programming points, virtual or real, for any specific device in the entire EMS network shall be accessible to all other network devices at any given time, regardless of physical location.
 - 7. All programming shall adhere to the BACnet protocols for Standard Command Priorities.
 - 8. Programming software must include a pre-developed cohesive PID (proportional-integral-derivative) algorithm whereby a user can adjust gain and anti-windup coefficients accordingly to effectively accomplish advanced sequence of operation requirements.

2.3 BUILDING (GLOBAL) CONTROLLER

- A. General Requirements
 - 1. Provide a minimum of one Alerton "ACM" per building.
- B. BACnet MS/TP
 - 1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
 - a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum
 - b. Provide sufficient installed LAN for 10% spare capacity on each LAN.
- C. BACnet IP
 - 1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN.
 - 2. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).
 - 3. Each controller shall support at a minimum 128 BBMD entries
 - 4. BBMD management architecture shall support 3000 subnets at a minimum Shall support BACnet Network Address Translation
 - 5. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- D. Expansion ports
 - 1. Controller shall support two expansion ports.
 - a. Combining the two on-board EIA-458 ports with fully loaded expansion ports the controller shall support 6 EIA-485 trunks simultaneously
 - 2. Expansion cards that mate to the expansion ports shall include:
 - a. Dual port EIA-485 card

2.4 ADVANCED APPLICATION CONTROLLERS

- A. Provide one or more native BACnet advanced application controllers for Central / Built up HVAC equipment requiring DDC standalone control independent of building control module operation. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.
- B. Acceptable Controllers
 - 1. ACM I/O with AXM Expansion Modules are to be used for Central Plants, large built-up AHUs or other equipment requiring multiple I/O to be coordinated in a single program.
 - 2. VLC1688 are to be used for smaller built-up AHUs, Boiler skids and other centralized equipment.
 - 3. All outputs must have on-board Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position. The position of each and every HOA switch shall be available system wide as a BACnet object property.
- C. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.
- D. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

2.5 APPLICATION SPECIFIC CONTROLLERS

- A. Provide one Alerton native BACnet application controller (VLC) for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. BACnet Conformance
 - 1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be

- thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of three (3) pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
 - D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
 - E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.6 VAV BOX CONTROLLERS

- A. Provide one native Alerton VLC BACnet application controller for each VAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure-independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- C. All program sequences shall be fully custom programmable. No factory pre-programmed sequences of operations are allowed. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall

be programmed using the same programming tool as Building Controller and as described in operator's workstation section. All programming tools shall be provided as part of system.

- D. Application controller shall include support for intelligent room sensor Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operations for specific display requirements for intelligent room sensor.
- E. On board flow sensor shall be microprocessor-driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in non-volatile memory. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator's workstation, portable computers, and special hand-held field tools shall not be needed for field calibration.
- F. Provide duct temperature sensor at discharge of each VAV reheat box that is connected to controller for reporting back to operators workstation.

2.7 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

- 1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with Touch Screen

- 1. Alerton MS-4 No Substitutions.
 - a. Room sensor shall include:
 - 1) Backlit touch screen LCD digital display
 - 2) Temperature sensor
 - 3) Humidity Sensor
 - 4) Programmable Status Light indicator
 - 5) CO2 Sensor (as scheduled on prints)
 - b. Temperature sensor shall be a Uni-Cuve Type II thermistor with an accuracy of +/- 0.36 °F (0.2 °C) at calibration point over the range of 32- 158 °F or better.
 - c. Humidity sensor shall have an accuracy of +/-3% from 10-90% relative humidity or better.
 - d. The intelligent room sensor's Smart Light shall have a minimum of four colors (Blue, Red, Amber and Green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of smart light shall be fully programmable.
 - e. CO2 Sensor shall have an accuracy of +/- 30 ppm over the range of 0- 5000 ppm or better.
 - f. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without need for manual calibration.
 - g. The user shall interact with the smart sensor using a touch screen, with no buttons allowed.
 - h. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.

- i. The touch screen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
 - j. Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.
 2. Display Content
 - a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
 - b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temp to customize the view for the customer.
 - c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Centigrade.
 - d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
 - e. Information about the version of firmware shall be displayable on the LCD screen.
 - f. A cleaning mode will be provided to allow for the touch screen to be cleaned without inadvertently making changes to system parameters.
 - g. The intelligent room sensor shall have the ability to display the status of a lighting zone status and control the on/off state of the zone from the touch screen using a tenant accessible display page.
 - h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g. blinds) and control the on/off state of the zone from the touch screen using a tenant accessible display page.
 - i. After Hours Override shall:
 - 1) Override time may be set and viewed in 30 minute increments.
 - 2) Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
 - 3) Time remaining shall be displayed.
 - 4) Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
- C. Blank Wall Sensor – Alerton Microset No substitutions.
 1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.
- D. Duct and Immersion Sensors – ACI 10k Ohm Sensor. Sized as appropriate for the intended use.
- E. Air Differential Pressure Sensors – Dwyer.
- F. Liquid / Steam Differential and Pressure Sensors – Veris
- G. Electric Submeters – Emon Dmon E50 Series
- H. Liquid Flow Meter – Onicon F1250 paddlewheel.
- I. Gas Flow Meter – Onicon
- J. Water Totalizing Meter – Badger

- K. Grey Water and Sewage Totalizing Meter – Flo-Dar
- L. Variable Frequency Drives – Honeywell
- M. Refrigerant Monitoring Systems – Honeywell Analytics
- N. Toxic Gas / O₂ Depletion Sensors – Honeywell Analytics
- O. VAV Fume Hood Systems:
 - 1. Venturi Style Airflow valves and associated fast acting actuators, Fume Hood Controller and Room Controllers to be by a single manufacturer.
 - 2. Phoenix or Price. No substitutions.

2.8 ELECTRONIC ACTUATORS AND VALVES

- A. Quality Assurance for Actuators and Valves
 - 1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
 - 2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
 - 3. Five-year manufacturer's warranty. Two-year unconditional and three- year product defect from date of installation.
- B. Execution Details for Actuators and Valves
 - 1. VAV box damper and reheat valve actuation in addition to Fan Coil primary valve actuation shall be floating type or analog (2–10 VDC, 4–20 mA).
 - 2. Primary valve control on Air Handling Units shall be analog (2–10 VDC, 4–20 mA).
- C. Actuators for damper and control valves 0.5–6 inches shall be Belimo electric unless otherwise specified, provide actuators as follows:
 - 1. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify actuators.
 - 2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
 - 3. Five-year manufacturer's warranty. Two-year unconditional and three- year product defect from date of installation.
 - 4. Mechanical spring shall be provided when specified. Capacitors or other non- mechanical forms of fail-safe are not acceptable.
 - 5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
 - 6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
 - 7. A pushbutton gearbox release shall be provided for all non-spring actuators.
 - 8. Modulating actuators shall be 24 VAC and consume 10 VA power or less.
 - 9. Conduit connectors are required when specified and when code requires it.
- D. Damper Actuators
 - 1. Economizer actuators shall utilize analog control 2–10 VDC; floating control is not acceptable.
 - 2. Electric damper actuators (including VAV box actuators) shall be direct shaft- mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Floating point actuators are acceptable. Single bolt or set- screw type fasteners are not acceptable.

3. One (1) electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one
 4. (1) actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
 5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One (1) electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)
- E. Valve Actuators 0.5–6 inches
1. All zone service actuators shall be non-spring return unless otherwise specified.
 2. The valve actuator shall be capable of providing the minimum torque required for proper valve close-off for the required application.
 3. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
 4. Override handle and gearbox release shall be provided for all non-spring return valve actuators.
- F. Control Valves 0.5–6 inches
1. Belimo. No substitutions. The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The plumbing contractor shall install all valves. Equal percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves that are 2.5 inches and above.
 2. Characterized control valves shall be used for hydronic heating or cooling applications and small to medium AHU water-coil applications to 100GPM. Actuators are non-spring return for terminal unit coil control unless otherwise noted. If the coil is exposed to the outside air stream, see plans for spring return requirement.
 - a. Leakage is 0% (zero percent), close-off is 200psi, maximum differential is 30psi; rangeability is 500:1.
 - b. Valves 0.5–2 inches shall be nickel-plated forged brass body, NPT screw type connections.
 - c. Valves 0.5–1.25 inches shall be rated for ANSI Class 600 working pressure. Valves 1.5 and 2 inches shall be rated for ANSI Class 400 working pressure.
 - d. The operating temperature range shall be 0–250 degrees F.
 - e. Stainless steel ball and stem shall be furnished on all modulating valves.
 - f. Seats shall be fiberglass reinforced Teflon.
 - g. Two-way and three-way valves shall have an equal percentage control port. Full stem rotation is required for maximum flow to insure stable BTU control of the coil.
 - h. Three-way valve shall be applicable for both mixing and diverting.
 - i. The characterizing disc is made of TEFZEL and shall be keyed and held secure by a retaining ring.
 - j. The valves shall have a blow-out proof stem design.
 - k. The stem packing shall consist of two (2) lubricated O-rings designed for on- off or modulating service and require no maintenance.
 - l. The valves shall have an ISO type, 4-bolt flange for mounting actuator in any orientation parallel or perpendicular to the pipe.
 - m. A non-metallic thermal isolation adapter shall separate valve flange from actuator.
 - n. One (1) fastening screw shall secure the direct coupling of the thermal isolation adapter between the actuator and the valve. This will prevent all lateral or rotational forces from affecting the stem and its packing O-rings.
 3. Globe valves 0.5–2 inches shall be used for steam control or water flow applications.
 - a. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
 - b. Valves 0.5 inches (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (0.1%).

- c. The operating temperature range shall be 20–280 degrees F.
 - d. Spring loaded TFE packing shall protect against leakage at the stem.
 - e. Two-way valves shall have an equal percentage control port.
 - f. Three-way valves shall have a linear control and bypass port.
 - g. Mixing and diverting valves must be installed specific to the valve design.
4. Globe Valves 2.5–6 inches
 - a. Valves 2.5 inches (DN65) through 6 inches (DN50) shall be iron body, 125 lb. flanged with Class III (0.1%) close-off leakage at 50 psi differential.
 - b. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (0.1%).
 - c. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
 - d. Mixing and diverting valves must be installed specific to the valve design.
- G. Butterfly valves
1. Butterfly valves shall be sized for modulating service at 60–70 degree stem rotation. Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats.
 - a. Body is cast iron.
 - b. Disc is aluminum bronze standard.
 - c. Seat is EPDM standard.
 - d. Body Pressure is 200 psi, -30–275 degrees F.
 - e. Flange is ANSI 125/250.
 - f. Media Temperature Range is -22–240 degree F.
 - g. Maximum Differential Pressure is 200 psi for 2- to 6- inch size.
- H. Butterfly Valve Industrial Actuators
1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
 - a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1pH, 60 Hz supply. Two (2) adjustable cam- actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
 - b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self- locking gear assembly or a brake shall be supplied.
 - c. Actuator shall have a 6-foot wiring harness provided for ease in field wiring (above 1500 in-lbs). Two (2) adjustable SPDT cam- actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
 - e. The actuator shall be analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2–10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.
 2. Actuator mounting for damper and valve arrangements shall comply with the following:
 - a. Damper actuators: Shall not be installed in the air stream.
 - b. A weather shield shall be used if actuators are located outside. For damper actuators, use clear plastic enclosure.

- c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
 - d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
 - e. Damper mounting arrangements shall comply to the following:
 - 1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - 2) No jack shafting of damper sections shall be allowed.
 - 3) Multi-section dampers shall be arranged so that each damper section operates individually. One (1) electronic actuator shall be direct shaft mounted per section.
 - f. Size damper sections based on actuator manufacturer's specific recommendations for face velocity, differential pressure and damper type. In general:
 - 1) Damper section shall not exceed 24 ft-sq. with face velocity >1500 FPM.
 - 2) Damper section shall not exceed 18 ft-sq. with face velocity > 2500 FPM.
 - 3) Damper section shall not exceed 13 ft-sq. with face velocity > 3000 FPM.
 - g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
 - h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8 inches wide by 6 inches deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft-mounting of actuators. Open side of channel shall be faced downstream of the airflow, except for exhaust air dampers.
 - i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal stand out collars. Sheet metal collars (12-inch minimum) shall bring each damper section out of the wall to allow direct shaft-mounting of the actuator on the side of the collar.
3. Valve Sizing for Water Coil
- a. On/Off control valves shall be line-size.
 - b. Modulating control valve body size may be reduced, at most, two (2) pipe sizes from the line size or not less than half the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
 - 1) Booster-heat valves shall be sized not to exceed 4–9psi differential pressure. Size valve for 50% valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 2) Primary valves shall be sized not to exceed 5–15psi differential pressure. Size valve for 50% valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 3) Butterfly valves shall be sized for modulating service at 60–70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
 - c. Valve mounting arrangements shall comply with the following:
 - d. Unions shall be provided on all ports of two-way and three-way valves.
 - e. Install three-way equal percentage characterized control valves in a mixing configuration with the "A" port piped to the coil.
 - f. Install 2.5 inches and above, three-way globe valves, as manufactured for mixing or diverting service to the coil.

2.9 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be either NEMA 3R or NEMA 4.
- C. All temperature control panels shall be fabricated in a UL-listed panel shop. Field assembled temperature control panels are not allowed.

PART 3 - PART 3: EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this section may properly commence.
- B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 REQUIREMENTS FOR SYSTEM CONTROLS

- A. Packaged ACUs (Alerton controls are to be used for unit control. Manufacturer on-board controls via software interface are not acceptable due to control limitations.)
- B. Air Handlers
- C. Exhaust Fans
- D. Kitchen Hoods
 - 1. Supply, install, program, commission a complete MELink VAV Kitchen Exhaust Control System as follows for each controlled hood / kitchen area:
 - a. System Controller
 - b. Infrared Hood Sensor
 - c. Hood Exhaust Temperature
 - d. Either wire Exhaust Fan control commands directly to exhaust fan, or transfer hardwired I/O via the BAS.
 - 2. Integrate VAV Kitchen Exhaust Control System to Alerton Building Automation System via BACnet. Map the following I/O at a minimum; Occupancy Status, Hood Temperature, Hood Exhaust Fan Speed Command, Hood Exhaust Fan actual Speed.
- E. Zone Level Control:
 - 1. Single Zone ACU Serving Classrooms / Conference Rooms
 - a. Each controller performing space temperature control provided with a matching room temperature sensor. Temperature is to be displayed. Setpoint adjustment is to be limited from 69F to 72F. CO2 is to be blank.
 - 2. Classroom / Office Area VAV/VAVRH System
 - a. VAV Controllers to be VAV-SD to match campus standards
 - b. Controllers to be Floating Point actuation
 - c. Each controller performing space temperature control provided with a matching room temperature sensor. Temperature is to be displayed. Setpoint adjustment is to be limited from 69F to 72F. CO2 is to be blank.

3. Demand Control Ventilation for Classroom / Conference Rooms over 6 seats
 - a. 1. Provide combination CO2/Temp MS4
4. MDF/IDF VRF Units
 - a. Syserco to provide and commission BACnet Gateways for VRF system integration into Compass platform
5. Laboratory Areas
 - a. Assuming sufficient Fume Hood Density for 5 year ROI, system to be VAV FH
 - b. Syserco to supply / install BACnet based VAV FH System.
 - c. System to be based upon Venturi Technology (Price, Phoenix or equivalent)

3.3 REQUIREMENTS FOR SYSTEM MONITORING

- A. ATS
 1. Position
- B. Refrigerant Monitoring Systems
- C. Toxic Gas / O2 Depletion Monitoring
 - a. Local Horn/Strobe inside/outside room
 - b. Horn Silence
 - c. Common Alarm
- D. Freezer Monitoring

3.4 REQUIREMENTS FOR SYSTEM INTEGRATION

- A. When the following equipment is present on a project it shall be integrated into the BAS preferably via BACnet. Individual system suppliers are responsible to provide appropriate open protocol translator with their equipment / package
- B. VFDs are to be supplied and commissioned by BAS Vendor and integrated via BACnet.
- C. VRF Systems. Gateway to be supplied and commissioned by BAS Vendor and integrated via BACnet.
- D. Chillers via BACnet
- E. Boilers via BACnet
- F. CHW and HW BTU Meters via BACnet
- G. VAV Laboratory Control Systems supplied, installed, commissioned by BAS Vendor and integrated via BACnet
- H. Lighting Control System (supplied/installed/commissioned by other) via BACnet.
- I. Emergency Generator & Fuel Oil System via Modbus
- J. Switchgear via Modbus
- K. Power Monitoring System via BACnet

3.5 REQUIREMENTS FOR METERING

- A. The following describe the minimum metering standards for District Projects.

1. Water (Main meter provided and installed by Others, connected to BMS by Syserco, sub-meters provided by Syserco, installed by Others and connected to BMS by Syserco). All points to be trended at 15 minute intervals:
 - a. Building main domestic meter
 - b. Building main irrigation meter
 - c. Kitchen domestic sub-meters (per kitchen)
 - d. Mechanical/makeup water sub-meter
 - e. Tower Blowdown Meter
2. Gas (Main meter provided and installed by Others, connected to BMS by Syserco, sub-meters provided by Syserco, installed by Others and connected to BMS by Syserco). All points to be trended at 15 minute intervals:
 - a. Building main gas meter
 - b. Kitchen gas sub-meters (per kitchen)
 - c. Boiler gas sub-meter
 - d. Domestic hot water sub-meter (one per hot water heater or bank of water heaters)
3. Electric (sub-meters to be provided and installed by Syserco, Main Meter provided and installed by Others, connected to BMS by Syserco). All points to be trended at 15 minute intervals:
 - a. Building main electric meter
 - b. Kitchen energy meter (per kitchen)
 - c. Electrical Plug loads sub-metering (per quadrant zone or floor)
 - d. Electrical lighting loads sub-metering (per quadrant zone or floor)
 - e. Electric vehicle sub-metering
 - f. MDF/IDF-Room plug loads sub-metering (per IDF room)
 - g. Mechanical main meter
 - h. Chiller Plant Energy Distribution metering (or Combined)
 - i. Boiler Plant Energy Distribution metering (or combined)
 - j. AHU metering via BACnet integration to VFDs or ACU.
 - k. Pump sub-metering via BACnet integration to VFDs. If no VFDs install submeter on common feed to pumps.
 - l. Cooling tower sub-metering via BACnet integration to VFDs. If no VFDs install submeter on common feed to Towers.
4. Sewage (to be provided and installed by Others, connected to BMS by Syserco):
 - a. Main lift station meter
 - b. Grease waster sub-metering (one per grease discharge)

B. Metering Data Displays:

1. Water Consumption and Sewer Data Screen.
2. Electrical Consumption Data Screen.

3.6 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.7 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum three (3) feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.

- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.8 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring associated with the EMS system. All wiring shall be installed neatly and professionally, in accordance with all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All wire in walls, concealed areas above ceilings is in plenum rated cable.
- G. Sensor wiring in walls is to include a backbox for sensor and conduit stub up from wall to ceiling cavity.
- H. All control wiring in mechanical, electrical, telephone and boiler rooms to be installed in EMT conduit. Exposed control wiring shall also be installed in raceways. All other control wiring to be installed without conduit neatly and inconspicuously per local code requirements.
- I. All penetrations in fire rated walls are to be fire sealed as per code.
- J. All tubing in concealed areas and interstitial spaces is FR Poly.
- K. All exposed tubing where exposed to damage is poly in conduit.
- L. Labeling:
 - 1. All control cables are to be tagged at each end with a unique brady label.
 - 2. Each panel is to be labeled with a Phenolic label corresponding to the As- Builts.
 - 3. Panel components are to be labeled with phenolic lables.
 - 4. All Mechanical Equipment sensors are to be labeled using Phenolic Lables, wire tied to the sensors.
 - 5. Each control panel is to include a non-laminated control printout inside a clear plastic envelope

3.9 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
 - 1. New buildings are to be added to existing "Home Page" of Server.

2. One Graphic shall be provided for each major mechanical system. Links are to be provided to integrated equipment (VFDs, Chillers, etc) for additional information available from equipment.
 3. "Omni-Graphic" Thermal Mapping Floor Plan Graphics are to be provided for all controlled spaces with links to the unitary equipment serving each zone.
 4. For each floor, Tabular Graphics listing all VAV Boxes / Terminal Equipment and their associated summary operational parameters shall be provided
 5. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization
1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trends
1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
 2. The following are the minimum trends to be configured for each project:
 - a. AHU Discharge Temp
 - b. AHU Duct Static
 - c. AHU VFD Speed Command
 - d. Chiller % RLA
 - e. CHWS Temp
 - f. CHWR Temp
 - g. CHW EOL DP
 - h. CHW VFD Speed Command
 - i. HWS Temp
 - j. HWR Temp
 - k. HW EOL DP
 - l. HW VFD Speed Command
 3. Additional Project Specific Trends are to be coordinated with Facilities personnel and commissioning agent during detailed design phase.
- E. Alarms
1. The following are the standard alarms to be configured for each project:
 - a. AHU Fan Failure (Supply / Return)
 - 1) IDF Room High Temp
 - 2) Exhaust Fan Failure
 - 3) Chiller Failure
 - 4) Tower Failure
 - 5) Boiler Failure
 - 6) Pump Failure
 2. Additional "Project Specific" Alarms are to be coordinated with Facilities during detailed design phase.
 3. Remote Alarm Annunciation: On a project specific basis, select critical alarms are to be annunciated remotely via Email to selected system operators

3.10 COMMISSIONING

- A. Prepare and start logic control system under provisions of this section.
- B. Start up and commission systems. Allow sufficient time for startup and commissioning prior to placing control systems in permanent operation.

- C. Every physical point verified by point to point verification and documented on a summary sheet when it is accepted
- D. All projects to test software sequences (except VAV boxes) via a functional test form. When a Cx agent is utilized on a project, the Cx agent will generate the functional test forms for use for pre-testing by the controls contractor
- E. VAV box functional testing shall be verified as part of the point to point testing and indicated on the point to point test form that flow and temperatures are maintained

3.11 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not be limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of three persons.
- C. Provide on-site training above as required, 8 hours as part of this contract.

END OF SECTION

SECTION 26 0000

ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide like items from one manufacturer.

2.2 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL approved or are not listed for installation.
- B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. Hazardous Materials:
 - 1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 26, Electrical Sections. In the absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch.
 - b. Wall access panels to be minimum of 12-inch by 12-inch.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.

- 3) Masonry: Karp DSC-214M.
- 4) 2 hour rated: Karp KPF-350FR.
- 5) Manufacturers: Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums:
 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

- G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.
- B. General:
 - 1. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.
 - 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 - 3. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
 - 4. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details.
 - 5. Provide means to prohibit excessive motion of electrical equipment during earthquake.

3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground conduit installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
 - a. Organize work to minimize duration of power interruption.
 - b. Coordinate utility service outages with utility company.

3.5 CUTTING AND PATCHING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
 2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bus duct and similar items until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, and individual Division 26, Electrical Sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical

Basic Requirements and individual Division 26, Electrical Sections.

- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start-up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
 - 6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
 - 2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 - 3. Examination:
 - a. Determine exact location of existing utilities and equipment before

- commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- b. Verify that abandoned wiring and equipment serve only abandoned facilities.
 - c. Demolition drawings are based on casual field observation and existing record documents.
 - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
 - 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
 - d. Report discrepancies to Architect before disturbing existing installation.
 - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
4. Execution:
- a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
 - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
 - e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
 - f. Extend circuiting and devices in existing walls to be furred out.
 - g. Remove abandoned wiring to source of supply.
 - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
 - j. Disconnect and remove abandoned panelboards and distribution equipment.
 - k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - l. Existing lighting which is to remain, leave luminaires in proper working order.
 - m. Repair adjacent construction and finishes damaged during demolition work.
 - n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel
 - d. Record Drawings
 - e. Warranty and Guaranty Certificates
 - f. Start-up/Test Document and Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.17 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
 - 1. Luminaires
 - 2. Panelboards
 - 3. Breakers
 - 4. Transformers
- B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
 - 1. Copper or aluminum conductors, buses, and motor/transformer windings.
 - 2. Steel and aluminum from raceways, boxes, enclosures, and housings.
 - 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION

FINELITE

Series 16 LED Indirect/Direct - 2E, 3E, & 4E



Refer to spec page for details

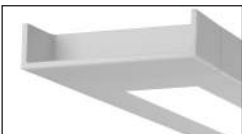
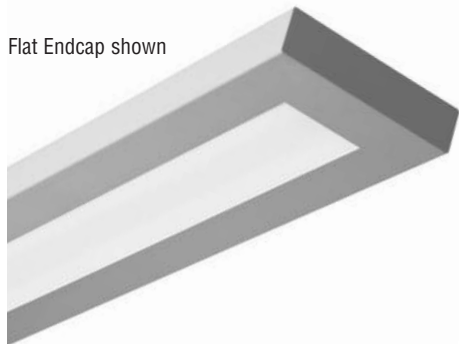
Date

Project

Type

Comments

Flat Endcap shown



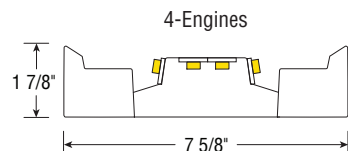
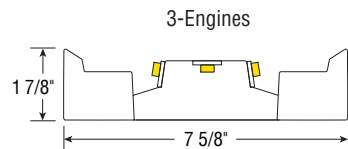
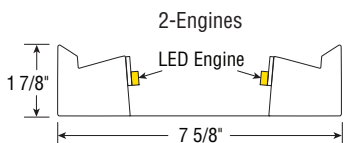
Extended Endcap

Signal White is standard finish

DESCRIPTION

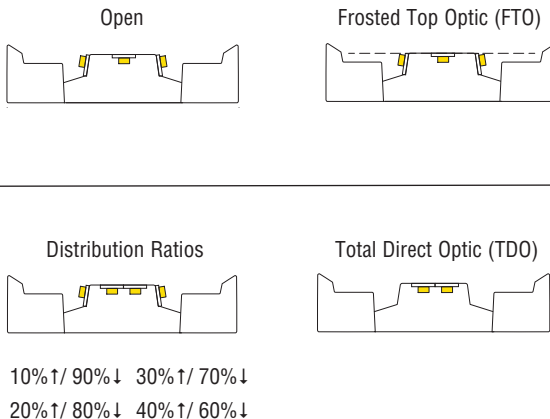
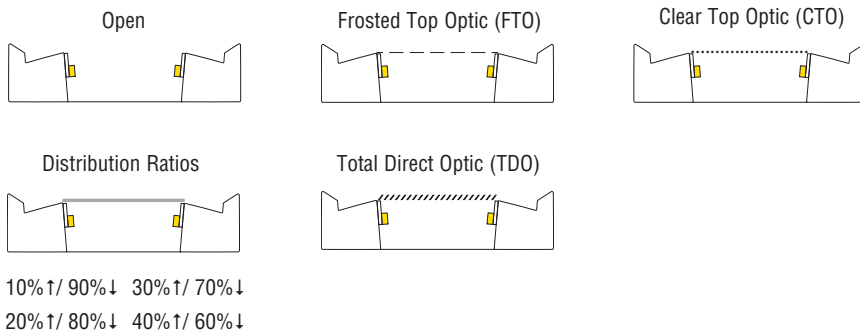
Series 16 LED is a low profile rectilinear form scaled to blend into any interior architecture and is available with three light engine models - 2E, 3E, and 4E. The luminaire uses mid-power LEDs for long life and enhanced performance.

LIGHT ENGINES



Available with factory presets in 3000, 4000, and 5000 lumens.

OPTIC & DISTRIBUTION RATIO OPTIONS



A brand of Legrand

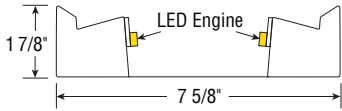


FINELITE

Series 16 LED Indirect/Direct - 2E

2E FEATURES

DIMENSIONS & LIGHT ENGINES

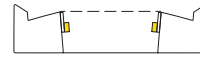


OPTIC OPTIONS

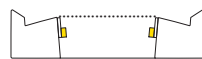
Open



Frosted Top Optic (FTO)

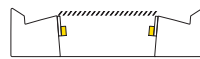


Clear Top Optic (CTO)



DISTRIBUTION RATIO OPTIONS

Total Direct Optic (TDO)



10U90D - 10% ↑ / 90% ↓
(includes CTO standard)

20U80D - 20% ↑ / 80% ↓
(includes FTO standard)

30U70D - 30% ↑ / 70% ↓
(includes FTO standard)

40U60D - 40% ↑ / 60% ↓
(includes FTO standard)

Date

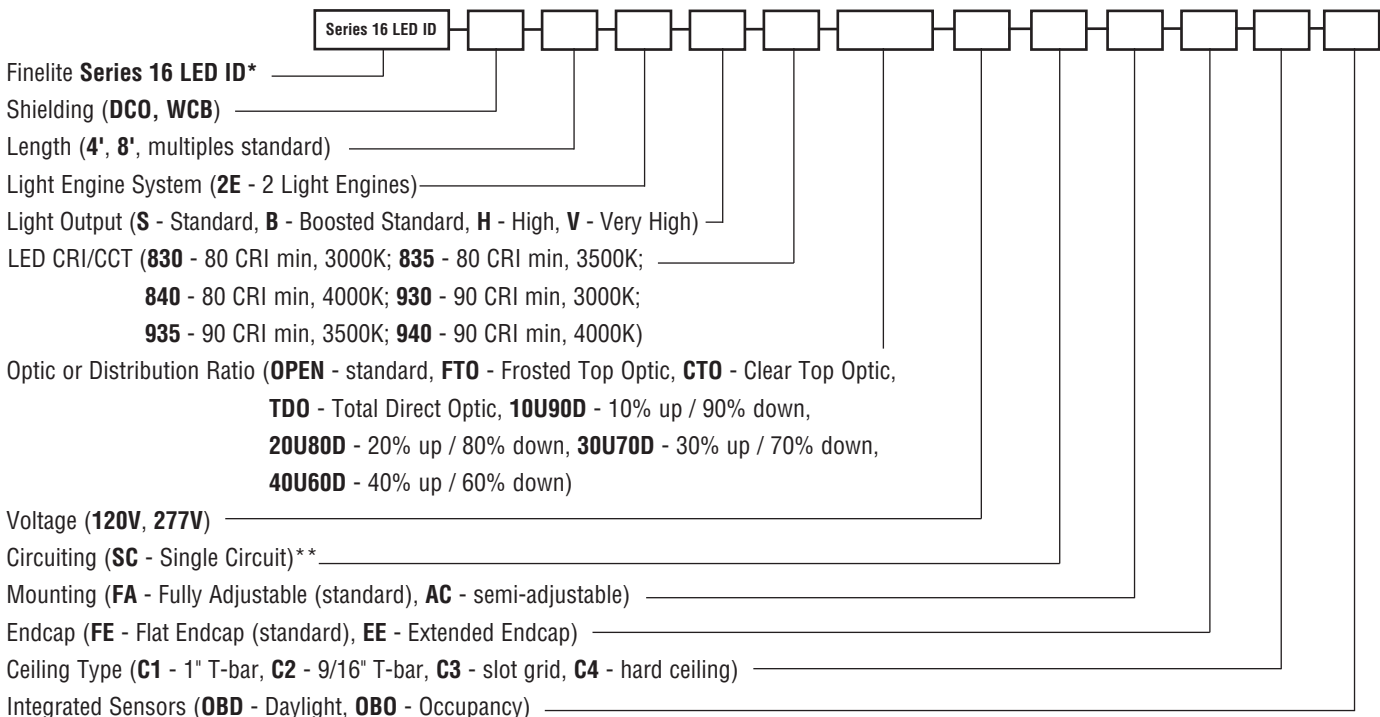
Project

Type

Comments

ORDERING GUIDE:

Sample Number: S16 LED ID - DCO - 8' - 2E - S - 835 - 20U80D - 120V - SC - FA - FE - C1 - OBO



* Indirect luminaires available on 2E.
** Contact factory for switching options.

FINELITE

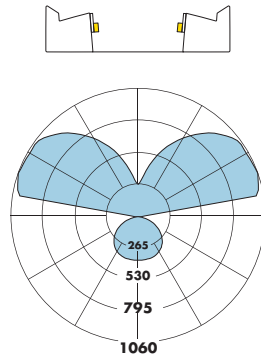
Series 16 LED Indirect/Direct - 2E

2E OPEN AND FTO PHOTOMETRY - 4 ft. Luminaire

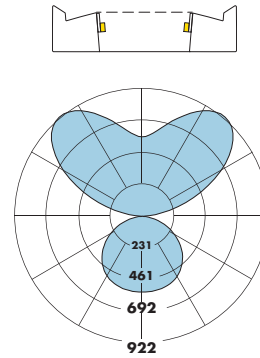
Series 16-LED-ID-DCO-2E-V-835-OPEN
 Distribution: 76% up / 24% down
 Efficacy: 127 lumens per watt
 Total Luminaire Output: 4722 lumens (1181 lumens/foot)
 37.3 watts (9.3 watts/foot)
 ITL LM79 Report 85120

Series 16-LED-ID-DCO-2E-V-835-FTO*
 Distribution: 63% up / 37% down
 Efficacy: 119 lumens per watt
 Total Luminaire Output: 4442 lumens (1111 lumens/foot)
 37.3 watts (9.3 watts/foot)
 ITL LM79 Report 85121

2E OPEN - REPORT 85120



2E FTO* - REPORT 85121



*For applications where a soft beam edge on wall or vertical surface is desired.

Refer to LM-79 reports for candlepower summaries

2E OPEN AND FTO

Total Light Output, 3500K, 80 CRI (Lumens) - 4 ft. Luminaire				
	S*	B*	H*	V**
OPEN	1933	2430	3673	4722
FTO	1818	2286	3455	4442

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	S*	B*	H*	V**
OPEN	483	608	918	1181
FTO	455	571	864	1111

Power (Watts Per Foot)				
	S*	B*	H*	V**
OPEN	3.7	4.6	7.2	9.3
FTO	3.7	4.6	7.2	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	S*	B*	H*	V**
OPEN	132	131	128	127
FTO	125	123	121	119

* Family Correlation based on 4 ft. luminaire 3500K Very High Output (V) test - 120V.

** Based on ITL reports above.

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

Lumen Adjustment Factors - 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors - 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (H), Open, 4000K, 90 CRI

$$\text{Lumen Adjustment Factor} = 0.789$$

$$\text{Total Light Output} = 3673 \text{ lm} \times 0.789 = 2898 \text{ lm}$$

$$\text{Total Light Output per Foot} = 918 \text{ lm/ft} \times 0.789 = 724 \text{ lm/ft}$$

$$\text{watts/foot} = 7.2 \text{ W/ft}$$

$$\text{Efficacy} = \frac{724 \frac{\text{lm}}{\text{ft}}}{7.2 \frac{\text{W}}{\text{ft}}} = 101 \text{ lm/W}$$

FINELITE

Series 16 LED Indirect/Direct - 2E

2E DISTRIBUTION RATIO PHOTOMETRY - 4 ft. Luminaire

Series 16-LED-ID-DCO-2E-V-835-10U90D

Efficacy: 84 lumens per watt
Total Luminaire Output: 3138 lumens (785 lm/ft)
37.2 watts (9.3 W/ft)

ITL LM79 Report 87819

Series 16-LED-ID-DCO-2E-V-835-30U70D

Efficacy: 94 lumens per watt
Total Luminaire Output: 3506 lumens (877 lm/ft)
37.2 watts (9.3 W/ft)

ITL LM79 Report 87821

Series 16-LED-ID-DCO-2E-V-835-TDO

Efficacy: 88 lumens per watt
Total Luminaire Output: 3261 lumens (815 lm/ft)
37.2 watts (9.3 W/ft)

ITL LM79 Report 87823

Series 16-LED-ID-DCO-2E-V-835-20U80D

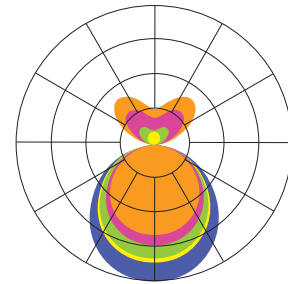
Efficacy: 85 lumens per watt
Total Luminaire Output: 3291 lumens (823 lm/ft)
37.2 watts (9.3 W/ft)

ITL LM79 Report 87820

Series 16-LED-ID-DCO-2E-V-835-40U60D

Efficacy: 99 lumens per watt
Total Luminaire Output: 3675 lumens (919 lm/ft)
37.2 watts (9.3 W/ft)

ITL LM79 Report 87822



10U90D

20U80D

30U70D

40U60D

TDO

Refer to LM-79 reports for candlepower summaries



2E DISTRIBUTION RATIOS

↑ Indirect

↓ Direct

Total Light Output, 3500K, 80 CRI (Lumens) - 4 ft. Luminaire

	S*	B*	H*	V**
10U90D	1285 [↑110% 90%↓]	1615 [↑110% 90%↓]	2441 [↑110% 90%↓]	3138 [↑110% 90%↓]
20U80D	1347 [↑117% 83%↓]	1694 [↑117% 83%↓]	2560 [↑117% 83%↓]	3291 [↑117% 83%↓]
30U70D	1435 [↑130% 70%↓]	1804 [↑130% 70%↓]	2727 [↑130% 70%↓]	3506 [↑130% 70%↓]
40U60D	1504 [↑140% 60%↓]	1891 [↑140% 60%↓]	2858 [↑140% 60%↓]	3675 [↑140% 60%↓]
TDO	1335 [↑10% 100%↓]	1678 [↑10% 100%↓]	2536 [↑10% 100%↓]	3261 [↑10% 100%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	S*	B*	H*	V**
10U90D	321	404	610	785
20U80D	337	423	640	823
30U70D	359	451	682	877
40U60D	376	473	715	919
TDO	334	420	634	815

Power (Watts Per Foot)

	S*	B*	H*	V**
10U90D	3.6	4.6	7.1	9.3
20U80D	3.6	4.6	7.1	9.3
30U70D	3.6	4.6	7.1	9.3
40U60D	3.6	4.6	7.1	9.3
TDO	3.6	4.6	7.1	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	S*	B*	H*	V**
10U90D	88	87	86	84
20U80D	92	92	90	88
30U70D	99	98	96	94
40U60D	103	102	100	99
TDO	92	91	89	88

Lumen Adjustment Factors - 80 CRI

3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors - 90 CRI

3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (H), 20U80D, 4000K, 90 CRI

Lumen Adjustment Factor = 0.789

Total Light Output =
2560 lm x 0.789 = 2020 lm

Total Light Output per Foot =
640 lm/ft x 0.789 = 505 lm/ft

watts/foot = 7.1 W/ft

$$\text{Efficacy} = \frac{505 \frac{\text{lm}}{\text{ft}}}{7.1 \frac{\text{W}}{\text{ft}}} = 71 \text{ lm/W}$$

* Family Correlation based on 3E 4 ft. Luminaire 3500K Very High Output (V) test - 120V.

S - Standard Output, B - Boosted Standard Output, H - High Output A brand of **legrand**

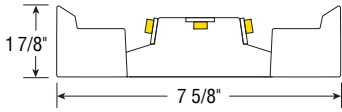


FINELITE

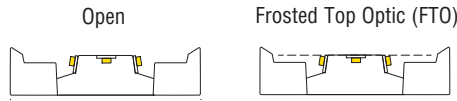
Series 16 LED Indirect/Direct - 3E

3E FEATURES

DIMENSIONS & LIGHT ENGINES



OPTIC OPTIONS

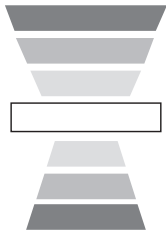


LUMEN PACKAGES

Available in four outputs.

- Standard Output
- Boosted Output
- High Output
- Very High Output

DIMMING



The uplight and downlight can be dimmed together or separately. 0-10V controls with a range of 10-100%. Dimming to 1% available.

Date

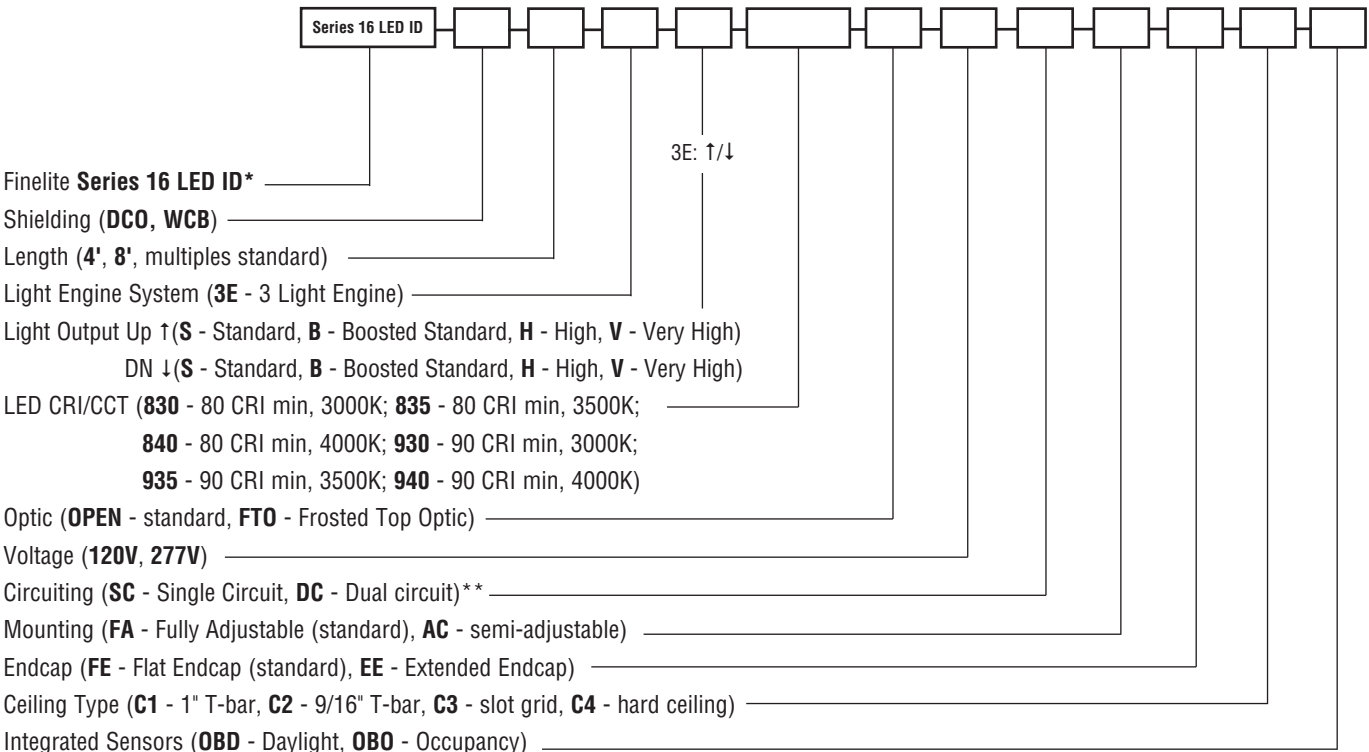
Project

Type

Comments

ORDERING GUIDE:

Sample Number: S16 LED ID - DCO - 8' - 3E - S/B - 835 - OPEN - 120V - SC - FA - FE - C1 - OBO

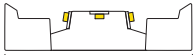


* Indirect luminaires available on 3E.
** Contact factory for switching options.

FINELITE

Series 16 LED Indirect/Direct - 3E

3E OPEN PHOTOMETRY - 4 ft. Luminaire



Series16-LED-ID-DCO-3E-V-V-835-OPEN

Distribution: 67% Up / 33% Down

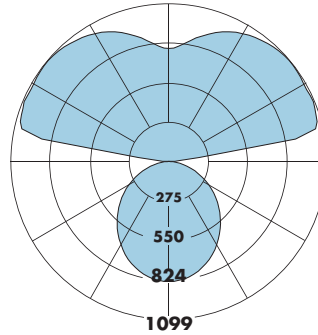
Efficacy: 117 Lumens per watt

Total Luminaire Output: 6657 lumens (1664 lumens/foot)

56.8 watts (14.2 watts/foot)

CCT: 3500K

ITL LM79 Report 85122



CANDLEPOWER SUMMARY						
	0	22.5	45.0	67.5	90.0	Flux
0	839	839	839	839	839	
5	835	834	834	835	834	79
15	800	795	798	798	794	224
25	728	720	723	722	719	332
35	629	623	624	620	618	389
45	515	510	510	505	503	393
55	394	389	387	383	383	346
65	266	263	261	257	257	258
75	138	137	135	134	133	144
85	30	31	31	31	31	36
90	0	0	0	0	0	
95	46	271	139	80	76	236
105	202	408	779	1000	1075	740
115	351	528	833	1021	1091	770
125	479	630	884	1045	1097	749
135	583	709	912	1046	1090	677
145	667	761	920	1023	1056	559
155	728	788	899	976	999	408
165	768	793	850	893	907	240
175	786	789	797	807	809	77
180	789	789	789	789	789	

3E OPEN

↑ Indirect	↓ Direct
------------	----------

Total Light Output, 3500K, 80 CRI (Lumens) - 4 ft. Luminaire				
	↑S*	↑B*	↑H*	↑V**
↓S*	2725 [↑67% 33%↓]	3194 [↑72% 28%↓]	4366 [↑79% 21%↓]	5356 [↑83% 17%↓]
↓B*	2957 [↑62% 38%↓]	3426 [↑67% 33%↓]	4598 [↑75% 25%↓]	5588 [↑80% 20%↓]
↓H*	3536 [↑52% 48%↓]	4005 [↑57% 43%↓]	5178 [↑67% 33%↓]	6168 [↑72% 28%↓]
↓V*	4026 [↑45% 55%↓]	4495 [↑51% 49%↓]	5667 [↑61% 39%↓]	6657 [↑67% 33%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S*	↑B*	↑H*	↑V**
↓S*	681	799	1092	1339
↓B*	739	856	1150	1397
↓H*	884	1001	1294	1542
↓V*	1006	1124	1417	1664

Power (Watts Per Foot)				
	↑S*	↑B*	↑H*	↑V**
↓S*	5.7	6.6	9.1	11.2
↓B*	6.2	7.1	9.6	11.7
↓H*	7.5	8.5	10.9	13.0
↓V*	8.6	9.6	12.1	14.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S*	↑B*	↑H*	↑V**
↓S*	120	121	120	119
↓B*	120	120	120	119
↓H*	118	118	119	118
↓V*	116	117	117	117

* Family Correlation based on 4 ft. luminaire 3500K Very High Output (V) test - 120V.

** Based on ITL report: 85122

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

Lumen Adjustment Factors - 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors - 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (H) / High Output (H),
Open, 4000K, 90CRI

Lumen Adjustment Factor = 0.789

Total Light Output =
5178 lm x 0.789 = 4085 lm

Total Light Output per Foot =
1295 lm/ft x 0.789 = 1022 lm/ft

watts/foot = 10.9 W/ft

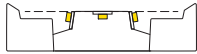
$$Efficacy = \frac{1022 \frac{lm}{ft}}{10.9 \frac{W}{ft}} = 94 \text{ lm/W}$$

A brand of Legrand

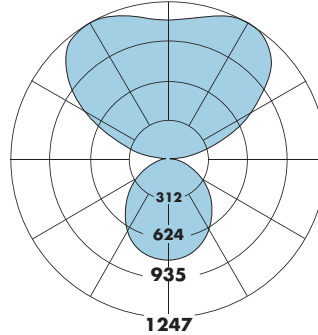
FINELITE

Series 16 LED Indirect/Direct - 3E

3E FROSTED TOP OPTIC (FTO) PHOTOMETRY - 4 ft. Luminaire



For applications where a soft beam edge on wall or vertical surface is desired.



Series16-LED-ID-DCO-3E-V-V-835-FTO

Distribution: 65% Up / 35% Down

Efficacy: 108 Lumens per watt

Total Luminaire Output: 6043 lumens (1511 lumens/foot)

56.2 watts (14.1 watts/foot)

CCT: 3500K

ITL LM79 Report 88524

CANDLEPOWER SUMMARY						
	0	22.5	45.0	67.5	90.0	Flux
0	799	799	799	799	799	
5	794	794	795	794	794	75
15	760	756	759	758	756	214
25	693	685	688	687	684	316
35	599	592	593	589	587	370
45	491	486	485	480	477	373
55	374	370	368	362	361	328
65	252	250	247	242	242	244
75	131	130	128	126	126	136
85	30	30	30	29	29	35
90	0	0	0	0	0	
95	59	63	65	61	58	75
105	223	240	278	297	303	287
115	415	455	538	588	607	518
125	606	671	798	880	911	693
135	778	851	998	1102	1140	752
145	916	974	1108	1207	1241	683
155	1013	1046	1137	1208	1232	521
165	1070	1080	1123	1154	1168	317
175	1096	1098	1101	1106	1108	105
180	1099	1099	1099	1099	1099	

3E Frosted Top Optics (FTO)

↑ Indirect	↓ Direct
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Total Light Output, 3500K, 80 CRI (Lumens) - 4 ft. Luminaire				
	↑S*	↑B*	↑H*	↑V**
↓S*	2474 [↑65% 35%↓]	2890 [↑70% 30%↓]	3930 [↑78% 22%↓]	4808 [↑82% 18%↓]
↓B*	2694 [↑60% 40%↓]	3110 [↑65% 35%↓]	4150 [↑74% 26%↓]	5028 [↑79% 21%↓]
↓H*	3244 [↑50% 50%↓]	3660 [↑56% 44%↓]	4700 [↑65% 35%↓]	5578 [↑71% 29%↓]
↓V*	3709 [↑44% 56%↓]	4125 [↑49% 51%↓]	5165 [↑60% 40%↓]	6043 [↑65% 35%↓]

Lumen Adjustment Factors - 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S*	↑B*	↑H*	↑V**
↓S*	618	722	982	1202
↓B*	673	777	1037	1257
↓H*	811	915	1175	1395
↓V*	927	1031	1291	1511

Lumen Adjustment Factors - 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

Power (Watts Per Foot)				
	↑S*	↑B*	↑H*	↑V**
↓S*	5.6	6.6	9	11.1
↓B*	6.1	7.1	9.5	11.6
↓H*	7.4	8.4	10.8	12.9
↓V*	8.6	9.5	11.9	14.1

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (H) / High Output (H),
Open, 4000K, 90CRI

Lumen Adjustment Factor = 0.789

Total Light Output =
4700 lm x 0.789 = 3708 lm

Total Light Output per Foot =
1175 lm/ft x 0.789 = 927 lm/ft

watts/foot = 10.8 W/ft

$$Efficacy = \frac{927 \frac{lm}{ft}}{10.8 \frac{W}{ft}} = 86 \text{ lm/W}$$

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S*	↑B*	↑H*	↑V**
↓S*	110	110	109	108
↓B*	110	110	109	108
↓H*	109	109	109	108
↓V*	108	108	108	108

* Family Correlation based on 4 ft. luminaire 3500K Very High Output (V) test - 120V.

** Based on ITL report: 88524

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output

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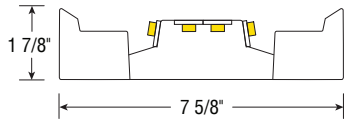


FINELITE

Series 16 LED Indirect/Direct - 4E

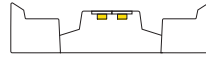
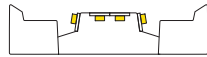
4E FEATURES

DIMENSIONS & LIGHT ENGINES



DISTRIBUTION RATIOS

Total Direct Optic (TDO)



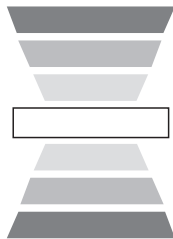
10U90D - 10%↑ / 90%↓

20U80D - 20%↑ / 80%↓

30U70D - 30%↑ / 70%↓

40U60D - 40%↑ / 60%↓

DIMMING



The uplight and downlight can be dimmed together or separately. 0-10V controls with a range of 10-100%. Dimming to 1% available.

PRESET OUTPUTS

Available with factory presets in 3000, 4000, and 5000 lumens.

Date

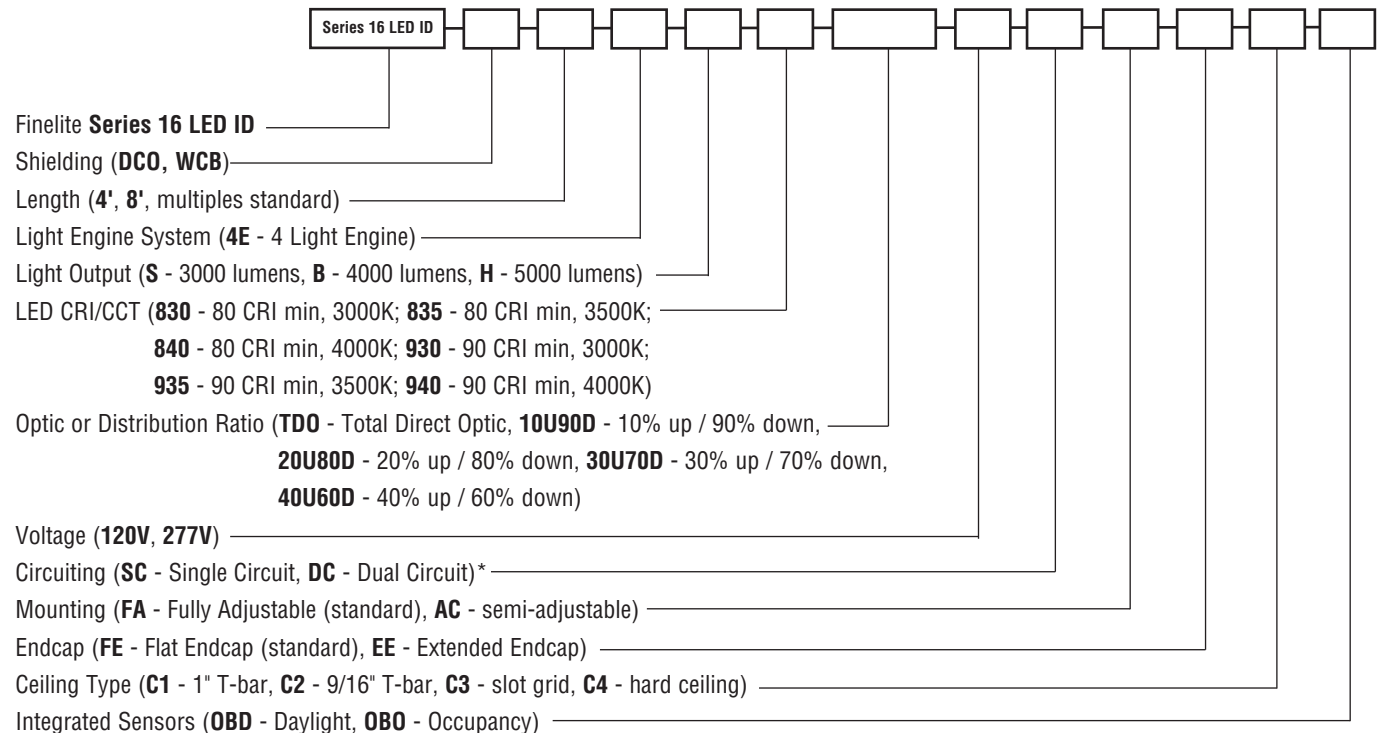
Project

Type

Comments

ORDERING GUIDE:

Sample Number: S16 LED ID - DCO - 8' - 4E - S - 835 - 10U90D - 120V - SC - FA - FE - C1 - OBO



* Contact factory for switching options.

FINELITE

Series 16 LED Indirect/Direct - 4E

4E DISTRIBUTION RATIO PHOTOMETRY - 4 ft. Luminaire

Series 16-LED-ID-DCO-4E-H-835-10U90D

Efficacy: 115 lumens per watt

Total Luminaire Output: 5000 lumens (1250 lm/ft)
43.6 watts (10.9 W/ft)

Source Report 85122 (Family Correlation)

Series 16-LED-ID-DCO-4E-H-835-30U70D

Efficacy: 117 lumens per watt

Total Luminaire Output: 5000 lumens (1250 lm/ft)
42.9 watts (10.7 W/ft)

Source Report 85122 (Family Correlation)

Series 16-LED-ID-DCO-4E-H-835-TDO

Efficacy: 115 lumens per watt

Total Luminaire Output: 5000 lumens (1250 lm/ft)
43.3 watts (10.8 W/ft)

Source Report 85122 (Family Correlation)

Series 16-LED-ID-DCO-4E-H-835-20U80D

Efficacy: 115 lumens per watt

Total Luminaire Output: 5000 lumens (1250 lm/ft)
43.6 watts (10.9 W/ft)

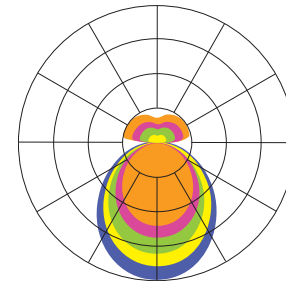
Source Report 85122 (Family Correlation)

Series 16-LED-ID-DCO-4E-H-835-40U60D

Efficacy: 117 lumens per watt

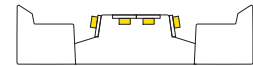
Total Luminaire Output: 5000 lumens (1250 lm/ft)
42.6 watts (10.7 W/ft)

Source Report 85122 (Family Correlation)



10U90D
20U80D
30U70D
40U60D
TDO

Refer to LM-79 reports for candlepower summaries



4E DISTRIBUTION RATIOS

Total Light Output, 3500K, 80 CRI (Lumens) - 4 ft. Luminaire

	S*	B*	H*
10U90D	3000	4000	5000
20U80D	3000	4000	5000
30U70D	3000	4000	5000
40U60D	3000	4000	5000
TDO	3000	4000	5000

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	S*	B*	H*
10U90D	750	1000	1250
20U80D	750	1000	1250
30U70D	750	1000	1250
40U60D	750	1000	1250
TDO	750	1000	1250

Power (Watts Per Foot)

	S*	B*	H*
10U90D	6.6	8.7	10.9
20U80D	6.6	8.7	10.9
30U70D	6.6	8.7	10.7
40U60D	6.6	8.6	10.6
TDO	6.4	8.6	10.8

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	S*	B*	H*
10U90D	115	115	115
20U80D	114	115	115
30U70D	114	115	117
40U60D	114	116	117
TDO	117	117	115

* Family Correlation based on 3E 4 ft. luminaire 3500K Very High Output (V) test - 120V.

S - Standard Output, B - Boosted Standard Output, H - High Output

Lumen Adjustment Factors - 80 CRI

3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors - 90 CRI

3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (H), 20U80D, 4000K, 90 CRI

Lumen Adjustment Factor = 0.789

Total Light Output =
5000 lm x 0.789 = 3945 lmTotal Light Output per Foot =
1250 lm/ft x 0.789 = 986 lm/ft

watts/foot = 10.9 W/ft

$$\text{Efficacy} = \frac{986 \frac{\text{lm}}{\text{ft}}}{10.9 \frac{\text{W}}{\text{ft}}} = 90 \text{ lm/W}$$

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Finelite, Inc. • 30500 Whipple Road • Union City, CA 94587-1530 • (510) 441-1100 • Fax: (510) 441-1510 • www.finelite.com



FINELITE

Series 16 LED Indirect/Direct - 2E, 3E, & 4E

SPECIFICATIONS

CONSTRUCTION: Body is 20-gauge die-formed steel with an 18-gauge die-formed internal joiner system. Plug-together wiring standard. All components are hard-tooled to tolerances of +/- 0.010".

ENDCAPS: The Flat Endcap (**FE**) is standard and made of 20-gauge die-formed steel adding 1/8" at each end. The optional Extended Endcap (**EE**) is an aluminum die-cast endcap with a 1/8" reveal adding 2-1/2" at each end.

OPTICS & DISTRIBUTION RATIOS:

Open	Standard (2E, 3E)
FTO	Frosted Top Optic (2E, 3E)
CTO	Clear Top Optic (2E)
TDO	Total Direct Optic (2E, 4E)
10U90D	10% up / 90% down (2E, 4E)
20U80D	20% up / 80% down (2E, 4E)
30U70D	30% up / 70% down (2E, 4E)
40U60D	40% up / 60% down (2E, 4E)

SHIELDING: Diffuse Center Optic (**DCO**), 73% transmissive, 99% diffusion. Visible diffuser: UV-stabilized and impact-resistant frosted virgin acrylic, 1/8" thick. Inner diffuser: 1/8" thick with 40% round perforations white/white. White Cross Baffle (**WCB**), 87 cell baffles spaced 1/2" apart and finished with 96% reflective white paint.

LIGHT OUTPUT:

2E & 3E: Four lumen packages available: Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**).

4E: Three lumen packages available, Standard (**S**), 3000 lumens, Boosted Standard (**B**), 4000 lumens, High (**H**), 5000 lumens.

A separate chart summarizes lumen distribution and wattage. Light engines are replaceable.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

DRIVER: Replaceable 120V/277V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%-100%. Dimming to 1% available; consult factory. Driver is fully accessible from below the ceiling. Power Factor: ≥ 0.9 . Total Harmonic Distortion (THD): $< 20\%$. Expected driver lifetime: 100,000 hours.

LUTRON DRIVER OPTIONS: **LUTES1** (Hi-lume 1% EcoSystem with Soft-On, Fade to Black dimming (LDE1 series)); **LUTES5** (5-Series 5% EcoSystem (LDE5 Series)), **LUT2W** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)); Contact factory for availability of discontinued Lutron drivers, L3DA-3-wire and L3DA EcoSystem.

ELECTRICAL: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery. Optional Chicago Plenum available.

2E: A factory-choice low-profile backup battery is available (8 ft. minimum fixture length). Backup batteries deliver 2361 lumens. A 4 ft. section will be illuminated in emergency mode.

3E: A factory-choice low-profile backup battery is available (8 ft. minimum fixture length). Backup batteries deliver 2202 lumens. The down-light engine will be illuminated in a 4 ft. section in emergency mode.

4E: A factory-choice low-profile backup battery is available (8 ft. minimum fixture length). Backup batteries deliver 2202 lumens. The down-light engine will be illuminated in a 4 ft. section in emergency mode.



INTEGRATED SENSORS: Daylight sensors and Integrated PIR (Passive Infrared) occupancy sensors available. Refer to Occupancy Sensor and Daylight Sensor tech sheets for more info.

MOUNTING: 50" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. Contact factory for additional lengths up to 150". Optional semi-adjustable Aircraft Cable (**AC**) ($\pm 1/2"$) in lengths of 12", 15", 18", 21", 24", 27", 30", and 36".

FINISHES: Finelite Signal White powder coat standard. Optional Adders: 185 RAL colors.

FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps.

LENGTHS: Standard 4 ft. and 8 ft. section lengths can be combined to make longer runs. Contact factory additional lengths.

LABELS: Fixture and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.73 (G), this luminaire contains an internal driver disconnect. Damp Location. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2011/65/EU.

WEIGHT: 3.0 lb/ft.

DLC QUALIFIED: Configurations of this product are listed on the DLC Qualified Products List (QPL). www.designlights.org/search

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

DESCRIPTION

The next generation of lighting is here with the architecturally inspired Divide™ series powered by WaveStream™ LED. The broad offering of efficient LED products include a complete family of recessed, linear suspended, surface, and wall mounted luminaires. The Divide's modern, ultra-shallow design is complemented with functionally engineered features for practical use. High performing Accu-Aim™ optics allow for maximum energy savings while achieving desired light levels. Available in 4', 8' and continuous run lengths, the Corelite Divide Suspended Series is ideal for open offices, private offices, retail, healthcare and educational facilities.

SPECIFICATION FEATURES

Construction

Nominal 2-1/4" x 12" housing constructed from extruded aluminum and die-formed 20 gauge cold rolled steel. Side panel assembly measures just 3/4" tall.

End Caps

Precision engineered 2-piece die cast aluminum alloy end caps attach mechanically to the end of the fixture without exposed fasteners visible from below the fixture. End cap adds 2-1/8" at each end.

Light Engine

LED's are available in 3000K, 3500K or 4000K with CRI options of either ≥80CRI or ≥90CRI. Lumen output will be affected - please refer to the lumen adjustment factor table.

Electrical

Long-Life LED system coupled with integral electronic drivers to deliver optimal performance. Standard with 120-277V 0-10V dimming drivers (1% standard). 347V 0-10V drivers are available. Dimming wires come standard but can be capped in the field for standard switched operation. A single power feed drop supplied as standard.

Controls

Options compatible with Eaton's Connected Lighting Systems:

- WaveLinx sensor
- LumaWatt Pro sensor
- Fifth Light DALI driver

Refer to the Connected Lighting options page and ordering information for more details.

Mounting

Aircraft cable mounts on 4'-0" and 8'-0" centers. Fixture is balanced to allow for minimal leveling and simple installation. All sections are continuously wired with push-in connectors for fast installation. Fixtures can be joined for straight continuous runs using patented Quick-Tab alignment features. Refer to installation instructions for various ceiling interface details.

Finish

Electrostatically applied polyester powder coat paint in white, silver, or black. RAL custom colors are available.

Catalog #		Type
Project		
Comments		Date
Prepared by		

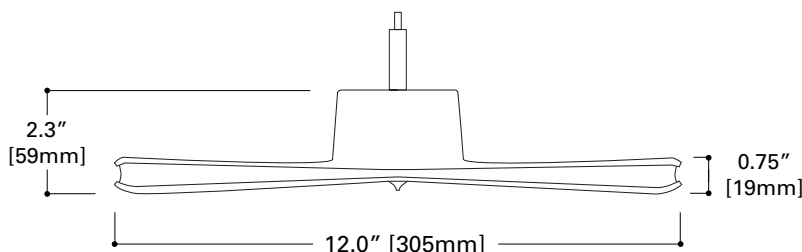


DIVIDE - DSI

WaveStream™ LED

Suspended
Direct / Indirect

cULus – 1598
Damp Location Listed
LM79/LM80 Compliant
ROHS Compliant
DesignLights Consortium™ Qualified



ORDERING INFORMATION

Sample Number: DSI-WS-40L835-1D-UNV-STD-SWPD1-DC-W-AC48-T1-16

Series	Shielding	Lumen Package Nominal per 4' section	Color Temperature	Number of Circuits	Additional Circuiting	Input Voltage
DSI = Divide Suspended Direct/Indirect	WS = WaveStream Specular Optic WD = WaveStream Diffuse Optic	20L = 2,000 Lms (500 lms/ft) 30L = 3,000 Lms (750 lms/ft) 40L = 4,000 Lms (1,000 lms/ft) 50L = 5,000 Lms (1,250 lms/ft) 60L = 6,000 Lms (1,500 lms/ft)	830 = 3000K, 80 CRI 835 = 3500K, 80 CRI 840 = 4000K, 80 CRI 930 = 3000K, 90 CRI 935 = 3500K, 90 CRI 940 = 4000K, 90 CRI	1 = Single Circuit	D = None (Default Dimming) E = Emergency Circuit S = Secondary Circuit N = Emergency + Secondary Circuit	120 = 120V 277 = 277V UNV = Universal (120V-277V) 347 = 347V
		Refer to performance table on Page 3 for more detail.	Additional lead-time may apply for 930, 935 and 940 configurations.	Refers to wiring in cross section.	Secondary circuit not available with integrated sensor options.	Integral 347V driver with STD 0-10V option only. Factory supplied 347V remote transformer for all other driver options.

Driver/Dimming Options	Integral Sensor	Integral Emergency	Top Cover	Finish	Suspension Length	Ceiling Type	Run Length
STD = Standard 0-10V (1%-100%) SR = Sensor Ready (1%-100%) 5LT = Fifth Light DALI (5%-100%) 5LTHD = Fifth Light DALI (1%-100%) LH = Lutron HiLume 1% EcoSystems L5 = Lutron 5-Series 5% EcoSystems	SWPD1 = WaveLinx Wireless Integrated Sensor LWIPD1 = LumaWatt Pro Wireless Integrated Sensor	EL14W = 14-watt, 120V-277V Emergency Battery Pack EPC = UL924 Bypass Relay	DC = Dust Cover FC = Frosted Cover SC = Solid Cover (100% Down) (blank) = No Cover	W = White S = Silver B = Black CC = Custom Color	Adj. Cable AC48 = 48" AC120 = 120" AC240 = 240" AC300 = 300" AC360 = 360"	T1 = 1" T-Bar T9 = 9/16" T-Bar TS = Slotted T-Bar ST = Structure JB = 4" Octagonal J-Box	4 = 4 ft 8 = 8 ft XX = Specify Row Length
LH and L5 driver options not available in 20L lumen package.	SW sensor must be used with "STD" driver. LWI sensor must be used with "SR" sensor ready driver. Integrated Sensors combined with Emergency Circuit require one UL924 Bypass Relay per emergency section.		Refer to photometric IES file data for top cover performance.		White mounting hardware standard; for black mounting hardware, add "-B" after ceiling type.		Standard row configurations over 8' consist of 4' and 8' luminaires.

Lengths

Available in 4-ft and 8-ft sections. All sections are modular eliminating the need for starter, joiner and end sections. Standard row configurations over 8-ft consist of 4-ft and 8-ft luminaires unless otherwise specified.

Optics

Optical grade acrylic embedded with patented Accu-Aim™ micro-optics for optimal distribution, low glare, and high performance. Specular (WS) or diffuse (WD) optical patterns are available to achieve the right look for any application. See page 3 photometric data for optical performance.

Top Cover Options

Dust Cover (DC) option is a clear formed polycarbonate for worry free cleaning and protection. Frosted Cover (FC) option is a frosted formed polycarbonate for worry free cleaning, reduced uplight, and protection. Solid Cover (SC) option is a high reflectance white powder coat painted steel reflector for 100% downlight.

Lumen Maintenance

Projected lumen maintenance based on TM-21 standards is L87 > 60,000 hours at 25°C ambient conditions.

Emergency Options

Optional 120V-277V integral emergency battery pack is 14W maximum, 90 minute output, and powers a 4-foot section. Test switch/indicator button located on the top side of the luminaire. Patented EZ Key prevents accidental discharge of the battery during construction. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 14 = 1400 lumens). The combination of integrated sensor and emergency circuit options require an EPC UL924 bypass relay that disables sensor control of emergency sections when normal power is lost.

Integrated Sensing and Control Systems

Integrated options must be used in conjunction with the associated system and may not be compatible

with other options or accessories. Please consult WaveLinx and LumaWatt Pro system pages for additional details and compatibility. Consult Marketplace Options - Lutron system pages for additional details and compatibility. Requires field commissioning to operate or dim. Contact Lutron at www.lutron.com.

Weight

6.0 lbs per foot.

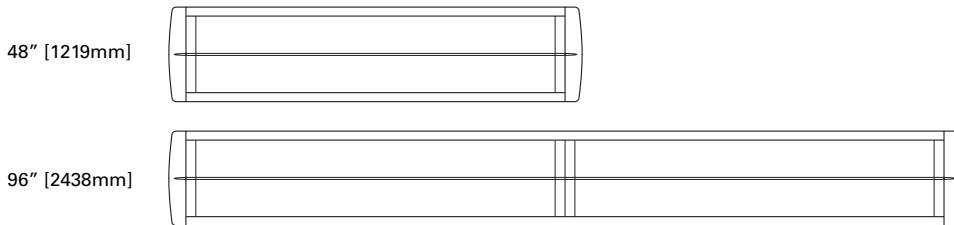
Compliance

Modules are UL recognized components and indoor luminaires are cULus listed for 25°C ambient environments, damp location listed, and RoHS compliant. LED modules comply with IESNA LM-79 and LM-80 standards. DesignLights Consortium™ Qualified and classified for DLC Standard and DLC Premium, refer to www.designlights.org for details.

Warranty

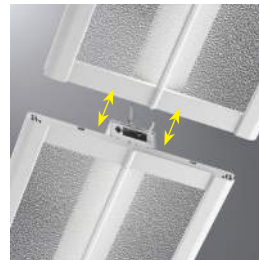
Five year warranty.

FIXTURE LENGTHS



SENSOR OPTIONS

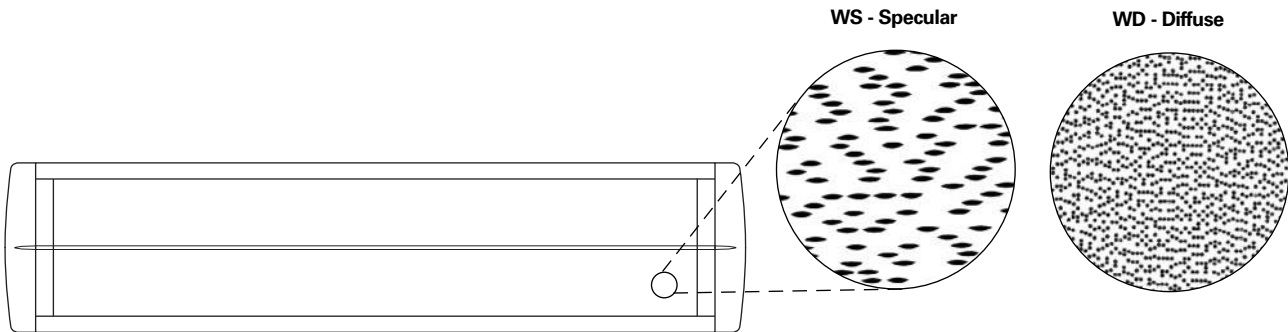
Integrated sensors are located in the endcap of 4' units and in the middle of 8' units for individual and continuous runs. Each unit is individually controllable and can be grouped together using a wireless control system.



QUICK-TAB ALIGNMENT

Corelite's patented quick-tab alignment system creates a seamless and simple installation every time. Simply align the tabs into the corresponding slots. The fixture can then hang freely while a single contractor makes the final connections; it all slides back together and is securely fastened in place.

WAVESTREAM ACCU-AIM OPTIC PATTERNS



ENERGY AND PERFORMANCE DATA

DIVIDE LINEAR SUSPENDED - DSI

Divide Suspended LED Light Level Outputs and Distributions (3500K, 80 CRI)								
Series	Lumen Package	Delivered Lumens		Wattage		Efficacy LPW	Distribution	
		4FT	Per FT	4FT	Per FT		% Up	% Down
DSI-WS	20L	2069	517	15.2	3.8	136	27%	73%
	30L	3000	750	22.4	5.6	134		
	40L	3995	999	29.9	7.5	134		
	50L	5039	1260	37.8	9.5	133		
	60L	5968	1492	46.7	11.7	128		
DSI-WD	20L	2123	531	15.2	3.8	140	29%	71%
	30L	3079	770	22.4	5.6	137		
	40L	4100	1025	29.9	7.5	137		
	50L	5172	1293	37.8	9.5	137		
	60L	6125	1531	46.7	11.7	131		

LUMEN ADJUSTMENT FACTORS

CCT	80 CRI	90 CRI
3000K	0.955	0.830
3500K	1.000	0.861
4000K	1.012	0.883

Example Calculation:

WS / 40L / 3500K / 80 CRI

Lumen Output selected = 999 lms/ft

3500K / 90 CRI Desired

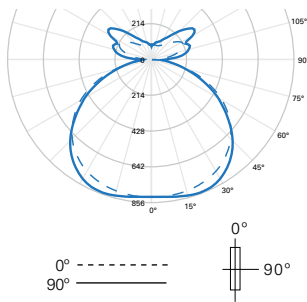
Lumen Adjustment Factor = 0.861

Adjusted Lumen Output = 999 lms/ft x 0.861 = 860 lms/ft

LUMEN MAINTENANCE

Ambient Temperature	TM-21 Lumen Maintenance (60,000 hours)	Theoretical L70 (Hours)
25°C	>87%	256,000

PHOTOMETRICS



FILE NAME: DSI-WS-40L835-1D-UNV-4.IES

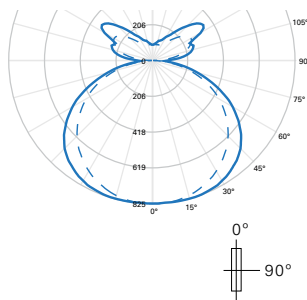
ZONAL LUMENS SUMMARY

LAMP: (LD2) LED 3500K
LUMENS: 3995 Lm
WATTS: 30.0 W
LPW: 133 Lm/W
TEST NO.: P35725
 27% UP / 73% DOWN

Zone	Lumens	% Fixture
0°-30°	697	17.4
0°-90°	2912	72.9
90°-130°	760	19.0
90°-180°	1083	27.1
0°-180°	3995	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	3218	3285	3304
55°	3310	3281	3193
65°	3282	3130	3027
75°	2927	2770	2718
85°	1931	2665	3167



FILE NAME: DSI-WD-40L835-1D-UNV-4.IES

ZONAL LUMENS SUMMARY

LAMP: (LD2) LED 3500K
LUMENS: 4100 Lm
WATTS: 30.0 W
LPW: 137 Lm/W
TEST NO.: P213060
 29% UP / 71% DOWN

Zone	Lumens	% Fixture
0°-30°	308	16.4
0°-90°	2910	71.0
90°-130°	821	20.0
90°-180°	1190	29.0
0°-180°	4100	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	2928	3168	3409
55°	2956	3301	3538
65°	2965	3319	3561
75°	2868	3210	3447
85°	1954	3048	3596

COLOR DATA (3500K)

		80CRI
TM-30-15	R _f	82.3
	R _g	94.4
CRI/CIE	R _a	84.0
	R ₉	17.2

FEATURES & SPECIFICATIONS

INTENDED USE — Built on the compact, low-profile Z strip channel, this LED strip offers long maintenance-free life, several color temperatures, lumen outputs and lengths. Ideal for new construction and retrofit applications in T8 lengths. Ideal for use in commercial, retail, office, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Compact-design channel and cover are formed from code-gauge cold-rolled steel. Easy to install six-point row aligner included for continuous row mounting.

Finish: Paint options include high-gloss, baked white enamel (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). After fabrication, five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Replaceable diffuse lens eliminates pixelation and offers ingress protection from debris.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications (see PLR_ordering information below). Electronic LED driver is rated for 75 input watts maximum (see Operational Data on page two for actual wattage consumption), **multi-volt input and 0-10V dimming standard.** This fixture is designed to withstand a maximum line surge of 1.5KV AT 0.75KA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

LEDs provide nominal 80CRI or 90CRI at 3000 K, 3500 K, 4000 K or 5000 K.

Lumen output up to 1,500 lumens per foot. Luminaire should be installed in applications where ambient temperatures do not exceed 86 °F (30 °C).

INSTALLATION — Fixture may be surface mounted (with or without ZSPRG hanger), pendant or stem mounted with appropriate mounting options. Six-point aligner locks in place for easy continuous row mounting.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 86°F (30°C).

WARRANTY — 5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Catalog Number
Notes
Type



Architectural LED Striplight

ZL1F

24", 48" and 96" Lengths



A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a **shaded background***

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

ZL1F LED Striplight



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: ZL1F L48 3000LM MDD MVOLT 40K 80CRI WH

Series	Length	Reflectors ¹	Nominal lumens ²	Diffuser	Voltage	Color temperature
ZL1F LED striplight	L24 24"	(blank) Less reflector SMR Symmetric	1500LM 1,500 lumens 2250 LM 2,250 lumens 3000 LM 3000 lumens	MDD Medium diffuse	MVOLT 120-277V 120 120V 208 208V 240 240V 277 277V 347 347V ³ 480 480V ³	30K 3000 K 35K 3500 K 40K 4000 K 50K 5000 K
	L48 48"	(blank) Less reflector ASR Asymmetric SMR Symmetric	3000LM 3,000 lumens 4500 LM 4500 lumens 6000 LM 6000 lumens			
TZL1F LED striplight	L96 96"	(blank) Less reflector SMR Symmetric	6000LM 6,000 lumens 9000LM 9,000 lumens 12000LM 12,000 lumens			

Color rendering index	Options	Paint finish
80CRI 80 CRI 90CRI 90 CRI	PLR Plug-in wiring ^{4,5} PLR1LVG Plug-in wiring-low voltage ^{4,5} E7W Emergency battery pack, 7W CA Title 20 Noncompliant ^{6,7} 2E7W Two Emergency battery packs, 7W CA Title 20 Noncompliant ^{6,7,8} E10WLCP Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS ^{6,7} 2E10WLCP Two Emergency battery packs, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS ^{6,7,8} E15WLCP Emergency battery pack, 15W Linear Constant Power, Certified in CA Title 20 MAEDBS ^{6,7,8} OUTEND Cord set to exit endplate of fixture	WH White GALV Galvanized MB Matte black SKGY Smoke gray
	Cord sets: ⁹ CS1W Straight plug, 120V CS3W Twist-lock, 120V CS7W Straight plug, 277V CS11W Twist-lock, 277V CS25W Twist-lock, 347V CS97W Twist-lock, 480V CS93W 600V SE00W white cord, no plug (no voltage required)	

Accessories: Order as separate catalog number.	
HC36	Hanger chain, 36"
ZACVH	Aircraft cable 10' (one pair)
ZLANGBKT	Luma-Tilt™ angle bracket
ZSPRG	For 15/16" T-grid only
SQ_	Stem kit, 2" increments up to 48"
LSXR	Sensor Switch® LSXR occupancy sensor ⁴
NPP16D	nLight® switching/dimming module

Reflectors: Order as separate catalog number.	
ZLR L24 SYM UPL WH	24" symmetric reflector with uplight, white finish
ZLR L24 SYM WH	24" symmetric reflector, white finish
ZLR L46 SYM UPL WH	46" symmetric reflector with uplight, white finish
ZLR L46 SYM WH	46" symmetric reflector, white finish
ZLR L48 ASY WH	48" asymmetric reflector, white finish
ZLR L48 SYM UPL WH	48" symmetric reflector with uplight, white finish
ZLR L48 SYM WH	48" symmetric reflector, white finish
ZLR L92 SYM UPL WH	92" symmetric reflector with uplight, white finish
ZLR L92 SYM WH	92" symmetric reflector, white finish
ZLR L96 SYM UPL WH	96" symmetric reflector with uplight, white finish
ZLR L96 SYM WH	96" symmetric reflector, white finish
UNIVERSAL REFL ALIGNER	Universal reflector aligners, quantity 1

Notes

- Optional. Reflectors ship separately.
- See Operational Data on page 3 for actual lumens.
- Not available with L24, 24" fixture. 347V and 480V utilize a step-down transformer.
- See ordering information on page 5. When choosing sensor options and PLR configuration, contact factory representative.
- Not available with cordsets.
- Not available with L24, 24" fixture. See spec sheet PS1055LCP, PS155LCP and PS750L for more information.
- Must specify voltage. 120, 208, 240, or 277V.
- Only available with the 8' (96") fixtures.
- Cordsets exit back of fixture unless OUTEND option is specified. Must specify voltage (not required when ordering CS93W).

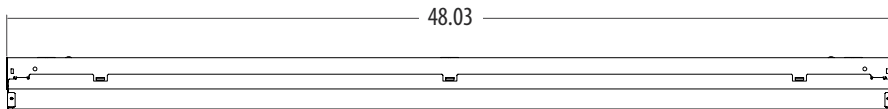
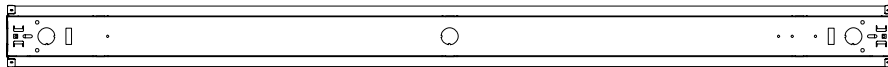
ZL1F LED Striplight

OPERATIONAL DATA												
	Nominal lumen package	Length (inches)	Delivered Lumens 3000 K CCT @ 77°F (25°C) ambient temperature		Delivered Lumens 3500 K CCT @ 77°F (25°C) ambient temperature		Delivered Lumens 4000 K CCT @ 77°F (25°C) ambient temperature		Delivered Lumens 5000 K CCT @ 77°F (25°C) ambient temperature		Wattage @ 120V/277V	Comparable Light Source
			80 CRI	90 CRI	80 CRI	90 CRI	80 CRI	90 CRI	80 CRI	90 CRI		
Lensed	1500LM	24	1281	1045	1310	1081	1330	1102	1379	1126	15	1-lamp 17W T8
	2250LM	24	1822	1486	1863	1538	1892	1567	1961	1602	19	1-lamp 17W T8
	3000LM	24	2623	2139	2682	2214	2724	2256	2824	2306	30	1-lamp 17W T8
	3000LM	48	2629	2144	2688	2219	2730	2261	2830	2311	30	1-lamp 17W T8
	4500LM	48	3714	3028	3796	3134	3856	3193	3997	3264	39	1-lamp 32W T8, 1-lamp 54W T5H0, 50W HID
	6000LM	48	4976	4057	5087	4200	5166	4279	5357	4374	56	1-lamp 32W T8, 1-lamp 54W T5H0, 70W HID
	6000LM	96	5143	4193	5257	4340	5339	4422	5536	4520	56	2-lamp 32W T8, 1-lamp 54W T5H0, 70W HID
	9000LM	96	7226	5891	7387	6098	7502	6214	7778	6352	77	3-lamp 32W T8, 2-lamp 54W T5H0, 100W HID
12000LM	96	10000	8153	10223	8439	10382	8599	10764	8790	114	4-lamp 32W T8, 2-lamp 54W T5H0, 100W HID	

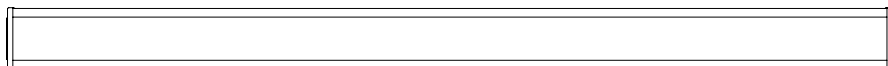
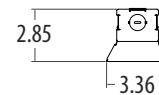
DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted.
Specifications subject to change without notice.

PALLET DIMENSIONS			
Length	Approximate weight	Fixtures per pallet	Approximate pallet dimensions (L x W x H)
L24	9 lbs.	96	46" X 51" X 32 5/16"
L48	18 lbs.	48	46" X 51" X 32 5/16"
L96	35 lbs.	48	46" X 98 1/2" X 32 1/16"

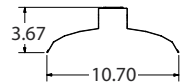
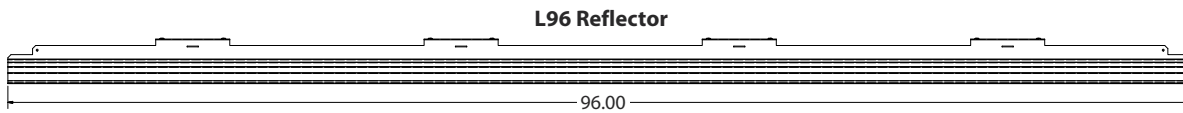
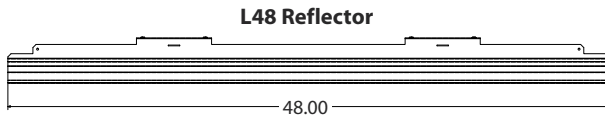
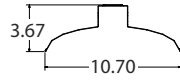
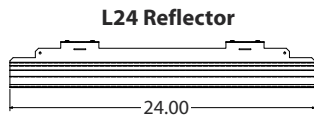


Knockout hole is .86in in diameter.



ZL1F LED Striplight

REFLECTORS (Optional)



PHOTOMETRICS

Please see www.lithonia.com

OPTIONS AND ACCESSORIES

The Z Series fixture offers numerous options for almost every electrical and optical component, including a long list of field-installable accessories.

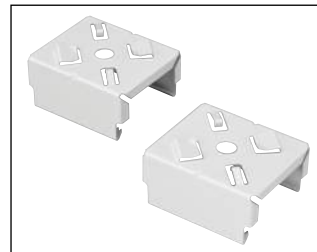


HANGER CHAIN

36" chain with Y hanger.

Order as:

HC36



Z SPRING HANGER

Snap 'n' lock design requires no fasteners and can be used on T-grid ceiling or universal mounting systems.

Order as:

ZSPRG

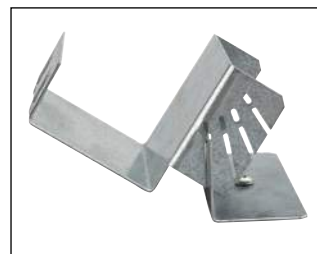


ZACVH HANGER

10' Aircraft cable with Y hanger.

Order as:

ZACVH



ANGLE MOUNTING BRACKET

Luma-tilt™ angle bracket ships as a pair

Order as:

ZLANGBKT

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.



PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires	Branch circuits	Dimming	Ground
PLR	(blank) Not required for 22	<u>Circuits to which ballast is connected</u>	LV Low-voltage dimming	G Ground
PLR22	1 Black	(blank) Not required for 22		
	2 Black and red	A Black wire		
		B Red wire		

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple circuit with night-lights located along row as desired

PRODUCT INFORMATION

A standard occupancy time delay is also present to ensure lights turn off (once minimum on timer has also elapsed) if no occupancy is detected.

This timer is factory set at 10 minutes to promote energy savings, but is adjustable between 30 seconds and 30 minutes. These adjustments may be done through the unit's push-button.

FEATURES

- Four interchangeable lenses - high mount 360°, low mount 360°, high mount aisleway, and small motion 360°.
- Integrated mounting bracket drops lens down 3" from chase nipple - no bracket accessory required.
- 100% digital PIR detection - provides excellent RF immunity

Note: Specifications subject to change without notice.

Passive Infrared Indoor Occupancy Sensor



LSXR

Single Relay

sensorswitch

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: LSXR 10 ADC HVOLT 30M

LSXR		Lens option				Dimming/photocell	
Series							
LSXR	Passive Infrared Indoor Occupancy Sensor	(blank)	No lens	610	High and low mount 360°	(blank)	None
		6	High mount, 360°	650	High mount 360° and aisleway	HL	High/low occupancy operation
		10	Low mount, 360°	3PK	High and low mount 360° and aisleway	P	Switching photocell (on/off)
		50	High mount aisleway	4PK	All lenses	ADC	Dimming and switching photocell
		9	Small motion, 360°			ANL	Dimming and switching photocell with high/low occupancy operation
Voltage	Max dim level	Min dim level		Lead length	Temp humidity		Default time delay
(blank) 120-277 VAC (MVOLT)	(blank) 10 VDC	(blank)	Minimum dimming level of ballast	(blank) 14"	(blank)	None	(blank) 10 minutes (with minimum 15 minutes on time)
HVOLT 347-480 VAC	9H 9 VDC	1V	1 VDC	42L 42"	LT	Low temperature	5M 5 minutes (LED only)
	8H 8 VDC	2V	2 VDC				15M 15 minutes
	7H 7 VDC	3V	3 VDC				20M 20 minutes
		4V	4 VDC				30M 30 minutes
		5V	5 VDC				
		6V	6 VDC				

For additional information see www.lithonia.com

DESCRIPTION

Designed with aesthetics as a high priority, the tasteful FVS4 combines style with strength. Ideally suited for high abuse areas, Fail-Safe's FVS4 is offered as ceiling- or wall-mounted, to provide general ambient illumination. Designed for use in public access areas where vandalism may occur and for areas that must maintain a clean, well-illuminated appearance.

Ideal for schools, dormitories, hallways, locker rooms, shower facilities, stairwells, restrooms, and storage facilities.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Fasteners

Captive, stainless steel tamperproof, T20 TORX ®-head screws prevent unauthorized access.

Housing

Die-formed 16 ga. Steel (FVS4P), 18 ga. Steel (FVS4M) with welded and ground ends. Stainless steel housing available.

Finish

Matte white electrostatically applied, white powder coat finish. Gloss white and anti-microbial white painted finish available.

Gasket

Concealed, polyurethane end gaskets inhibit the entrance of environmental contaminants.

Lens

Nominal 0.125", UV stabilized, clear Pattern 12, impact-resistant, prismatic polycarbonate refractor for high efficiency, low surface brightness and maximum strength. Opal smooth available. .187" thick clear Pattern 12 prismatic polycarbonate available.

Lifetime Lens Warranty

LEDs

Available with 3000K, 3500K, 4000K, 5000K with minimum of 80CRI. Projected life is 50,000 hours at 70% lumen maintenance.

Lens Retention

The FVS4P double wall lens channel captivates lens to prevent unauthorized fixture penetration. Screws along each side to ensure maximum lens captivation. FVS4M incorporates (2) tamper resistant screws, one on each endcap.

Transformer/Driver

Electronic driver 120V-277V, 0-10V, dimming standard.

Compliance

UL listed for damp location. Wet location listed under covered ceiling optional. (FVS4P only).

Warranty

5 Year warranty on LED's and electrical. Lifetime warranty if fixture found to be inoperative due to physical abuse for duration of the installation.



FVS4 FVS4W

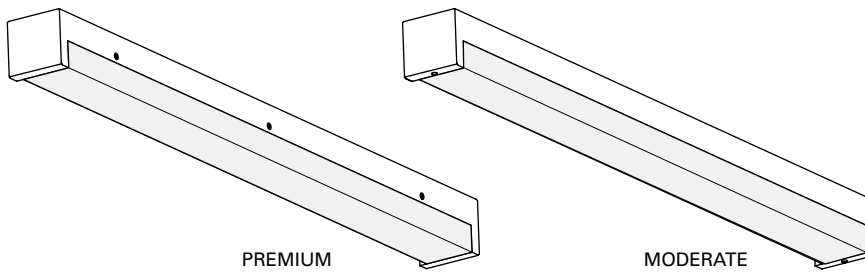
LD4 LED

4" Wide
2', 3', 4', 8' Length
Polycarbonate Lens
Vandal Resistant

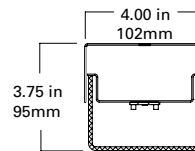
Ceiling/Wall

FVS4P

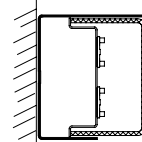
FVS4M



CEILING or WALL MOUNT
FVS4



WALL MOUNT
FVS4W



FVS4P	
Length	# Screws each side
2'	2
3'	2
4'	3
8'	5

Housing	FVS4P	FVS4M
	16GA Steel	18GA Steel
Listing	ETL Damp, Wet Optional	ETL Listed Damp Location
Construction	Screws along fixture edge	Set Screws on Endcaps

TORX® is a registered trademark of Camcar Division of Textron Inc.

ENERGY DATA

For Energy Management related technical data to support the performance of this fixture series, refer to the ordering information for input wattage.

ORDERING INFORMATION

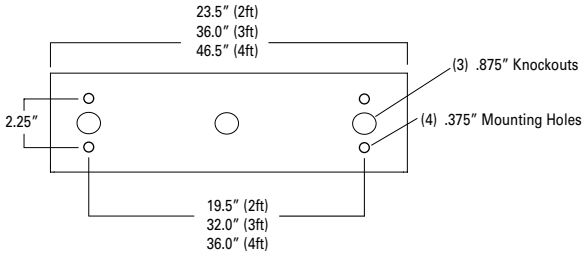
SAMPLE NUMBERS: FVS4WM-8-LD4-2STD-35-UNV-OPL-EDC1-EL7W
 FVS4P-4-LD4-2STD-30-120-P187-EDC1-OS1-WL

Product Family	Length	LED	No. of LEDs	Illumination Level	Color Temp	Voltage	Lens	Driver	Options
FVS4		LD4							
FVS4 =High Abuse 4" Wide Surface Luminaire FVS4W =High Abuse 4" Wide Surface Wall Mount Luminaire M =Moderate P =Premium 2=2' length ^{4, 6} 3=3' length 4=4' length 8=8' length		LD4 =Linear LED, Version 4 1=1 row LED module in X-section ^{1, 4} 2=2 rows LED module in X-section		LO =Low STD =Standard HI =High 30=3000K 35=3500K 40=4000K 50=5000K 120 =120 Volt 277 =277 Volt UNV =120-277 Volt			P125 = .125" Clear polycarbonate prismatic lens P187 = .187" Clear polycarbonate prismatic lens OPL = .125" Polycarbonate smooth opal lens		EL7W =7 watt EM Pack ^{1, 2} EL14W =14 watt EM Pack ^{1, 2} SHP =Stainless steel, painted housing SHB =Stainless steel, brushed housing OS1 =Internal Occupancy Sensor ^{5, 6} (behind lens), connected to one LED module. Specify 120 or 277 voltage. OS2 =Internal Occupancy Sensor ^{5, 6} (behind lens), connected to two LED modules. Specify 120 or 277 voltage. WL =Wet location, listed under ³ covered ceiling (FVS4P only)
							EDC1 =Electronic driver, Non-Dimming, 1 circuit EDC2 =Electronic driver, Non-Dimming, 2 circuits EDD1 =Electronic driver, Dimming 10%, 1 circuit EDD2 =Electronic driver, Dimming 10%, 2 circuits ED1D1 =Electronic driver, Dimming 1%, 1 circuit ED1D2 =Electronic driver, Dimming 1%, 2 circuits		

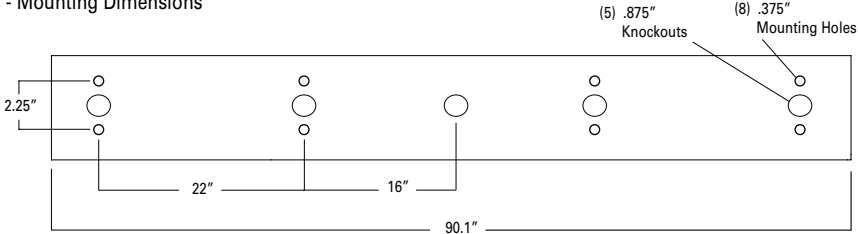
- Notes:**
- Up to 1HI only with Emergency Battery Pack. 1LO, 1STD, 1HI available with EL7W and EL14W. 2 LED cross-section not available.
 - EL7W not available in 2ft length. EL14W not available in 2ft or 3ft length.
 - FVSP Only.
 - 2HI with 2 circuits not available in 2ft length.
 - OS1 and OS2 require 120 or 277 to be specified in the ordering logic.
 - 2' length fixture with 2 circuits and OS1 or OS2 is not available.

MOUNTING DIMENSIONS

2',3',4' - Mounting Dimensions



8' - Mounting Dimensions



NOMINAL INPUT WATTS

LENGTH	# Modules in Cross-Section	Illumination Level	Nominal Input Watts	Color Temp	LENS P125 Nominal Delivered Lumens	LENS P187 Nominal Delivered Lumens	LENS OPL Nominal Delivered Lumens
2'	1	LO	12.3	30	1266	1230	849
				35	1290	1254	865
				40	1316	1279	882
				50	1434	1394	961
	1	STD	16.9	30	1723	1675	1155
				35	1756	1707	1177
1	HI	22.2	30	2125	2065	1425	
			35	2166	2105	1452	
3'	2	LO	24.1	30	2614	2540	1648
				35	2664	2588	1679
				40	2717	2640	1713
				50	2962	2878	1867
	2	STD	33.9	30	3475	3376	2190
				35	3541	3440	2232
2	HI	44.8	30	4266	4145	2689	
			35	4347	4223	2740	
4'	1	LO	21.3	30	2384	2254	1545
				35	2429	2296	1574
				40	2478	2343	1606
				50	2701	2553	1751
	1	STD	28.5	30	3067	2899	1988
				35	3125	2954	2025
1	HI	36.3	30	3699	3497	2397	
			35	3770	3564	2442	
5'	2	LO	56.8	30	5909	5575	3567
				35	6022	5682	3635
				40	6142	5795	3708
				50	6695	6317	4042
	2	STD	64.0	30	6545	6175	3951
				35	6671	6294	4027
2	HI	71.7	30	7136	6733	4308	
			35	7273	6862	4390	
6'	1	LO	23.6	30	2594	2515	1707
				35	2643	2563	1739
				40	2696	2614	1774
				50	2939	2850	1934
	1	STD	33.6	30	3476	3370	2287
				35	3542	3434	2330
1	HI	44.5	30	4274	4144	2812	
			35	4356	4224	2866	
7'	2	LO	57.4	30	6015	5848	3756
				35	6130	5960	3828
				40	6253	6080	3905
				50	6816	6627	4256
	2	STD	67.5	30	6853	6663	4279
				35	6984	6791	4361
2	HI	89.3	30	8335	8104	5205	
			35	8494	8259	5304	
			40	8664	8424	5410	
			50	9444	9182	5897	

Catalog Number
Notes
Type

FEATURES & SPECIFICATIONS

INTENDED USE

Provides task or accent lighting in commercial, retail, hospitality and residential applications. Ideal for use under and over cabinets, display cases, task lighting, office lighting, coves and utility/work areas.

CONSTRUCTION

Low profile design, with on/off rocker switch. Can be direct wired or powered by 5' cord-and-plug (not included, see accessories). Connect up to 354 watts of fixtures with 13" connector cord or 7/8" end row connector (Included).

Rugged post-painted low-profile steel housing with white finish. Acrylic white diffuser provides soft widespread illumination with zip-lock design for easy installation, cleaning, and superior retention.

ELECTRICAL

Long-life LEDs, coupled with a high-efficiency driver, provide extended service life. Fixture is rated to deliver L70 performance at 50,000 hours and operates at 120 volts, 60Hz. Minimum starting temp -20F. Can direct-wire through rear access plate/knockout by utilizing the included Romex connector or by utilizing the optional UCD JB Junction/Splice box (sold separately).

Works with most standard incandescent dimmers (see list of approved dimmers).

INSTALLATION

All mounting hardware included.

LISTINGS

UL listed to US and Canadian safety standards. ENERGY STAR® certified product (3000K and 4000K only) and Title 24 qualified. Listed for damp locations.

WARRANTY

5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.

Indoor General Purpose

UCEL LED Linkable Cabinet Light

Linkable



SPECIFICATIONS	1'	2'	3'	4'
Lumens (3000K):	388	742	1162	1603
Watts (3000K):	5.8	10.2	14.8	19.5
Lumens per watt:	67	73	79	82
Length:	12 (30.5)	24 (61)	36 (91.4)	48 (121.9)
Width:	2.83 (7.2)	2.83 (7.2)	2.83 (7.2)	2.83 (7.2)
Height:	1.03 (2.6)	1.03 (2.6)	1.03 (2.6)	1.03 (2.6)
Weight:	1 (.45)	1.5 (.7)	2.3 (1)	3 (1.4)

All dimensions are inches (millimeters) unless otherwise indicated. Weights are pounds (kilograms).

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**.

Example: UCEL 12IN 30K 90CRI SWR WH

Series	Length	Color temperature	CRI	Options	Finish
UCEL Economy LED Undercabinet	12IN 1' Nominal 24IN 2' Nominal 36IN 3' Nominal 48IN 4' Nominal	30K 3000K	90CRI >90	SWR On/off Rocker Switch	WH White

Accessories: Order as separate catalog number.

UC SFT POWERCORD WH	White 5' cord and plug
UCD JB	White Junction/Splice box - allows for quick and easy direct wiring (UC ERC24 also required for splice box to first fixture)
UC ERC	White 7/8" row connector for end-to-end connections (1 included with each fixture)
UC ERC24	White 24" connector cord for longer length connections between fixtures or splice box (required for splice box to first fixture)

UCEL LED Cabinet Light

PHOTOMETRIC DIAGRAMS

Photometry derived in accordance with IESNA LM41 procedure. Vertical and horizontal illuminance is calculated with fixture mounted 17" from work surface. Full photometric data report available within 2 weeks from request. Consult factory.

Report ISF 30163 UCCEL 121N

Initial Point Illuminance on wall and horizontal work surface. (fc)

X and Y coordinates are on 6" centers.

	X	A	B	C	D	E	F	G	H	I	
Vertical	1	2	5	11	21	26	21	11	6	2	Avg.=10 fc Max.=29 fc; Min.=1 fc Max. to min. ratio =29
	2	3	7	15	25	29	25	16	7	3	
	3	4	7	12	18	21	18	12	7	4	
Horizontal	4	6	10	18	27	31	27	18	10	6	Avg.=10 fc Max.=43 fc; Min.=1 fc Max. to min. ratio =43
	5	6	13	24	37	43	37	24	13	6	
	6	6	11	21	33	38	33	21	11	6	
	7	4	7	12	17	19	17	12	7	4	
	8	2	4	5	7	8	7	5	4	2	
	9	1	2	2	3	3	3	2	2	1	

Report ISF 30163 UCCEL 241N

Initial Point Illuminance on wall and horizontal work surface. (fc)

X and Y coordinates are on 6" centers.

	X	A	B	C	D	E	F	G	H	I	
Vertical	1	4	9	22	41	49	41	22	9	4	Avg.=20 fc Max.=56 fc; Min.=2 fc Max. to min. ratio =28
	2	6	13	28	48	56	48	28	13	6	
	3	7	13	23	35	40	35	23	13	7	
Horizontal	4	11	20	35	52	59	52	35	20	11	Avg.=18 fc Max.=83 fc; Min.=1 fc Max. to min. ratio =83
	5	12	24	46	71	83	71	46	24	12	
	6	11	22	41	63	73	63	41	22	11	
	7	7	13	22	32	36	32	22	13	7	
	8	4	7	10	13	15	13	10	7	4	
	9	2	4	5	6	6	6	5	4	2	

Report ISF 30163 UCCEL 361N

Initial Point Illuminance on wall and horizontal work surface. (fc)

X and Y coordinates are on 6" centers.

	X	A	B	C	D	E	F	G	H	I	
Vertical	6	14	34	64	77	64	34	14	7	1	Avg.=32 fc Max.=88 fc; Min.=4 fc Max. to min. ratio =22
	10	21	44	75	83	75	44	21	10	1	
	11	20	37	55	62	55	37	20	11	2	
Horizontal	17	31	55	82	92	82	55	31	17	3	Avg.=29 fc Max.=130 fc; Min.=2 fc Max. to min. ratio =65
	19	38	72	112	130	112	73	38	19	3	
	17	34	99	114	99	114	99	34	17	3	
	11	21	35	50	57	50	35	21	11	3	
	7	11	16	21	23	21	16	11	7	2	
	4	6	7	9	10	9	7	6	4	1	

Report ISF 30163 UCCEL 481N

Initial Point Illuminance on wall and horizontal work surface. (fc)

X and Y coordinates are on 6" centers.

	X	A	B	C	D	E	F	G	H	I	
Vertical	1	9	19	47	88	106	88	47	19	9	Avg.=43 fc Max.=122 fc; Min.=5 fc Max. to min. ratio =22.4
	2	14	29	61	103	122	103	61	29	14	
	3	15	28	51	75	86	75	51	28	15	
Horizontal	4	23	42	70	112	127	112	70	42	23	Avg.=40 fc Max.=179 fc; Min.=2 fc Max. to min. ratio =89.5
	5	26	52	100	154	179	154	100	52	26	
	6	24	47	89	136	157	136	89	47	24	
	7	16	29	48	69	78	69	48	29	16	
	8	9	15	22	29	32	29	22	15	9	
	9	5	8	10	12	13	12	10	8	5	

LIGHTING FACTS

Lithonia Lighting

LED lighting facts
A Program of the U.S. DOE

Light Output (Lumens)	385
Watts	5.8
Lumens per Watt (Efficacy)	66.38

Color Accuracy
Color Rendering Index (CRI) **94**

Light Color
Correlated Color Temperature (CCT) **3000 (Bright White)**

2700K 3000K 4500K 6500K

Warm White Bright White Daylight

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-WAT16M (2/11/2016)
Model Number: UCEL 12IN 33K 90CRI
Type: Luminaire - Desk/Task

Lithonia Lighting

LED lighting facts
A Program of the U.S. DOE

Light Output (Lumens)	740
Watts	10.2
Lumens per Watt (Efficacy)	72.55

Color Accuracy
Color Rendering Index (CRI) **94**

Light Color
Correlated Color Temperature (CCT) **3000 (Bright White)**

2700K 3000K 4500K 6500K

Warm White Bright White Daylight

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-WBAX5U (2/11/2016)
Model Number: UCEL 24IN 33K 90CRI
Type: Luminaire - Desk/Task

Lithonia Lighting

LED lighting facts
A Program of the U.S. DOE

Light Output (Lumens)	1160
Watts	14.8
Lumens per Watt (Efficacy)	78.38

Color Accuracy
Color Rendering Index (CRI) **94**

Light Color
Correlated Color Temperature (CCT) **3000 (Bright White)**

2700K 3000K 4500K 6500K

Warm White Bright White Daylight

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-RCJ505 (2/11/2016)
Model Number: UCEL 36IN 33K 90CRI
Type: Luminaire - Desk/Task

Lithonia Lighting

LED lighting facts
A Program of the U.S. DOE

Light Output (Lumens)	1600
Watts	19.5
Lumens per Watt (Efficacy)	82.05

Color Accuracy
Color Rendering Index (CRI) **94**

Light Color
Correlated Color Temperature (CCT) **3000 (Bright White)**

2700K 3000K 4500K 6500K

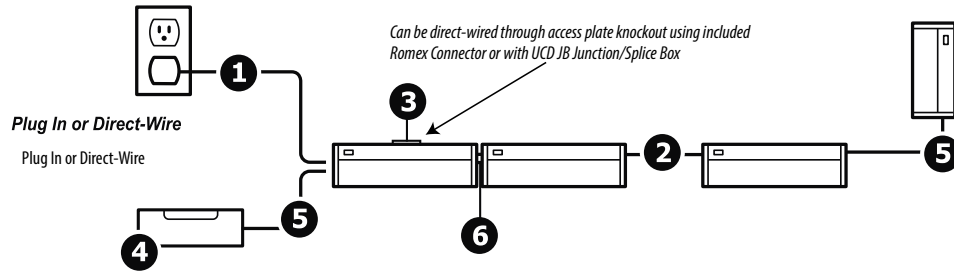
Warm White Bright White Daylight

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

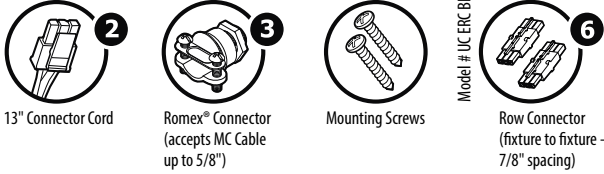
Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-FCE0YQ (2/11/2016)
Model Number: UCEL 48IN 33K 90CRI
Type: Luminaire - Desk/Task

Installation

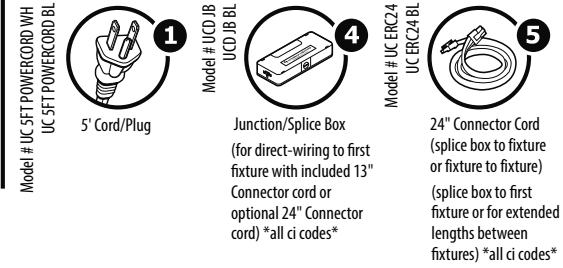


Included



Accessories

sold separately



COMPATIBLE DIMMERS

The UCEL is designed to operate with most standard Triac Based dimmers and is not compatible with 0-10v dimming systems. The following is a list of dimmers tested and does not imply any guarantee or warranty of compatibility with a particular application. Unlisted dimmers do not imply non-compatibility.

Manufacturer	Part number(s)
Lutron	Diva DVELV-300P (ELV) Skylark SELV-300P (ELV) Diva DV-600P (Triac) Nova NTELV-300V (ELV)
Leviton	SureSlide 6633-PA (Triac) SureSlide 6615-P (ELV)
Pass & Seymour	HCL453PTCCCV6 (triac)
Synergy	ISD 600 I 120
SensorSwitch	nLight1 nSP5 PCD 2W nLight3 nSP5 PCD ELV 120

EBVTPLED Series

Vapor Tight Luminaire



Standard

The EBVTPLED is a surface-mounted LED luminaire, which is designed to prevent the intrusion of moisture and dust. The EBVTPLED provides general ambient lighting in commercial and industrial settings, and is the perfect choice for both new construction and retrofits. This high-efficacy luminaire provides long-life and uniform illumination, as well as standard 0-10vdc dimming capability.

Features

- Available in 3500k (warm/neutral white), 4000k (neutral white) and 5000k (cool white) color temperatures.*
- Long-life LEDs provide at least 89,000 hours of operation with at least 70% of initial lumen output (L70).**
- EBVTPLED-35 provides 4,244 luminaire lumens (125 LPW) at 3500k; 4,550 luminaire lumens (130 LPW) at 4000k; and 4,585 luminaire lumens (131 LPW) at 5000k.*
- EBVTPLED-40 provides 4,793 luminaire lumens (120 LPW) at 3500k; 5,200 luminaire lumens (130 LPW) at 4000k; and 5,240 luminaire lumens (131 LPW) at 5000k.*
- EBVTPLED-52 provides 6,469 luminaire lumens (127 LPW) at 3500k; 6,760 luminaire lumens (130 LPW) at 4000k; and 6,812 luminaire lumens (131 LPW) at 5000k.*
- Uniform illumination with no visible LED pixelation.
- Universal 120-277 AC voltage (50-60Hz) is standard.
- 0-10vdc dimming capability is standard.
- Power factor > 0.90.
- Total harmonic distortion < 20%.
- Color rendering index > 80.
- ABS (acrylonitrile butadiene styrene) housing and polycarbonate lens.
- Stainless steel mounting bracket and lens clips are standard.
- Heavy duty wall-mount bracket provides for secure wall and ceiling installation.
- Easy installation in new construction or retrofit.

* Contact factory for other color temperatures and lumen packages.

** L₇₀ hours are IES TM-21-11 calculated hours.

Ordering Information

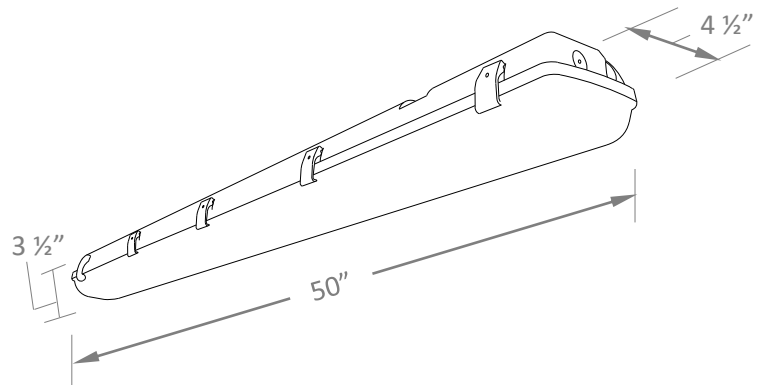
* Please note to select the size when filling out the model section



Warranty & Listings

- cULus approved for wet locations (-20 C to 50 C / -4 F to 122 F).
- IP65 rated for ingress protection.
- DLC premium approved.
- Complies with FCC Part 15, Class A.
- Complies with IEEE C.62.41-1991, input transient protection (2.5kV).
- Complies with RoHS (Restriction on Hazardous Substances) requirements.
- 5-year warranty of all electronics and housing.

Dimensions



Product Number: EBVTPLED Series **M:** **CT:** **LL:** **LW:** **L/W:** **O:**

Model	Color Temperature	Luminaire Lumens	Luminaire Watts	Lumens / Watt	Options (Order Separately)
EBVTPLED-35-35KMV-ET	3500k	4,244	35	125	MC613VDRC = Internal occupancy sensor
EBVTPLED-35-4KMV-ET	4000k	4,550	35	130	
EBVTPLED-35-5KMV-ET	5000k	4,585	35	131	
EBVTPLED-40-35KMV-ET	3500k	4,793	40	120	BLEDEM-CP-800 = Emergency driver (800 lm)
EBVTPLED-40-4KMV-ET	4000k	5,200	40	130	BLEDEM-CP-1200 = Emergency driver (1200 lm)
EBVTPLED-40-5KMV-ET	5000k	5,240	40	131	
EBVTPLED-52-35KMV-ET	3500k	6,469	52	127	BLEDEM-CP-1600 = Emergency driver (1600 lm)
EBVTPLED-52-4KMV-ET	4000k	6,760	52	130	
EBVTPLED-52-5KMV-ET	5000k	6,812	52	131	
07.2019					

Electrical

Model	Color Temp.	CRI 1	Luminaire Lumens	Luminaire Watts	Lumens Per Watt	Input Voltage ²	Input Current (A)			Power Factor	THD ³	L70 Hours ⁴
							120V	240V	277V			
EBVTPLD-35-35KMV- ET	3500k	> 80	4,244	35	125	120-277	0.28	0.14	0.12	> 90%	< 20%	105,000
EBVTPLD-35-4KMV- ET	4000k	> 80	4,550	35	130	120-277	0.29	0.15	0.13	> 90%	< 20%	105,000
EBVTPLD-35-5KMV- ET	5000k	> 80	4,585	35	131	120-277	0.29	0.15	0.13	> 90%	< 20%	105,000
EBVTPLD-40-35KMV- ET	3500k	> 80	4,793	40	120	120-277	0.33	0.17	0.14	> 90%	< 20%	104,000
EBVTPLD-40-4KMV- ET	4000k	> 80	5,200	40	130	120-277	0.33	0.17	0.14	> 90%	< 20%	104,000
EBVTPLD-40-5KMV- ET	5000k	> 80	5,240	40	131	120-277	0.33	0.17	0.14	> 90%	< 20%	104,000
EBVTPLD-52-35KMV- ET	3500k	> 80	6,469	52	127	120-277	0.43	0.21	0.18	> 90%	< 20%	89,000
EBVTPLD-52-4KMV- ET	4000k	> 80	6,760	52	130	120-277	0.43	0.22	0.19	> 90%	< 20%	89,000
EBVTPLD-52-5KMV- ET	5000k	> 80	6,812	52	131	120-277	0.43	0.22	0.19	> 90%	< 20%	89,000

¹ Color rendering index.

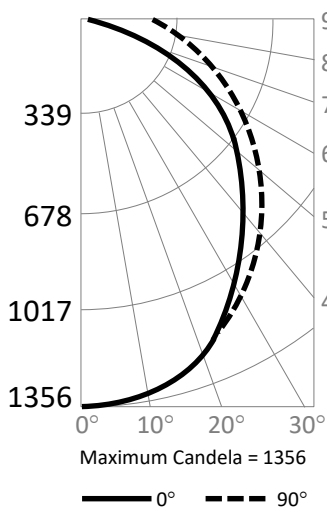
² All 50-60Hz.

³ Total harmonic distortion.

⁴ L70 refers to the number of hours at which lumen output declines to 70% of the initial level. L70 hours are IES TM-21-11 calculated hours.

Photometric Data

Model: EBVTPLD-35-35KMV (4,244 lumens)



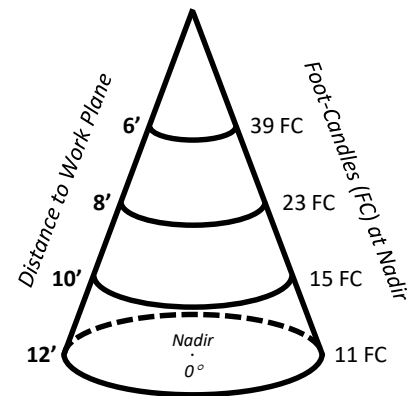
Candlepower Summary

	0°	90°
0°	1,356	1,356
10°	1,326	1,329
20°	1,234	1,242
30°	1,088	1,122
40°	902	987
50°	698	841
60°	493	692
70°	297	540
80°	119	378
90°	17	240

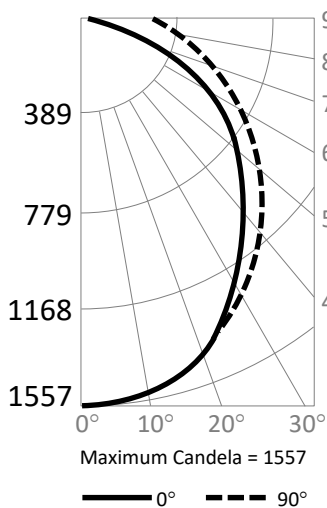
Zonal Lumen Summary

Zone	Lumens	% Fixture
0° – 10°	128	3.0%
0° – 20°	489	11.5%
0° – 30°	1,026	24.2%
0° – 40°	1,661	39.1%
0° – 50°	2,313	54.5%
0° – 60°	2,912	68.6%
0° – 70°	3,403	80.2%
0° – 80°	3,752	88.4%
0° – 90°	3,957	93.2%
90° – 180°	287	6.8%
0° – 180°	4,244	100.0%

Cone of Light



Model: EBVTPLD-40-35KMV (4,793 lumens)



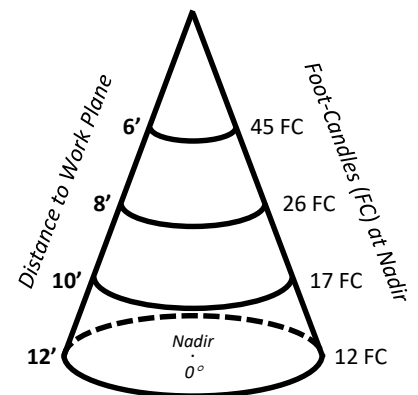
Candlepower Summary

	0°	90°
0°	1,557	1,557
10°	1,521	1,524
20°	1,416	1,413
30°	1,245	1,267
40°	1,027	1,110
50°	788	941
60°	547	772
70°	326	610
80°	131	424
90°	18	259

Zonal Lumen Summary

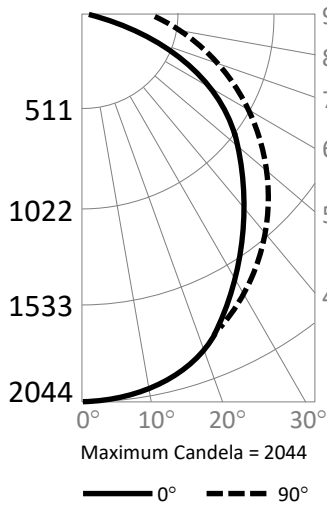
Zone	Lumens	% Fixture
0° – 10°	147	3.1%
0° – 20°	562	11.7%
0° – 30°	1,176	24.5%
0° – 40°	1,899	39.6%
0° – 50°	2,638	55.0%
0° – 60°	3,311	69.1%
0° – 70°	3,861	80.6%
0° – 80°	4,254	88.8%
0° – 90°	4,486	93.6%
90° – 180°	307	6.4%
0° – 180°	4,793	100.0%

Cone of Light



Photometric Data

Model: EBVTPLED-52-35KMV (6,469 lumens)



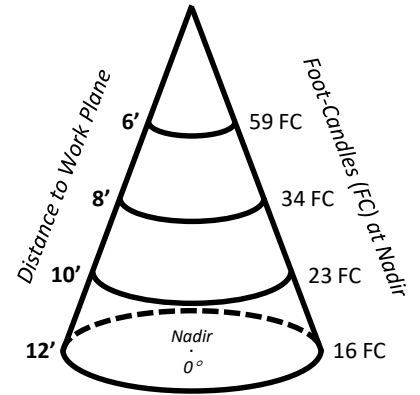
Candlepower Summary

	0°	90°
0°	2,044	2,044
10°	2,003	2,013
20°	1,867	1,895
30°	1,643	1,701
40°	1,356	1,505
50°	1,030	1,313
60°	709	1,075
70°	415	807
80°	164	546
90°	24	344

Zonal Lumen Summary

Zone	Lumens	% Fixture
0° – 10°	193	3.0%
0° – 20°	743	11.5%
0° – 30°	1,561	24.1%
0° – 40°	2,527	39.1%
0° – 50°	3,521	54.4%
0° – 60°	4,436	68.6%
0° – 70°	5,185	80.1%
0° – 80°	5,713	88.3%
0° – 90°	6,027	93.2%
90° – 180°	442	6.8%
0° – 180°	6,469	100.0%

Cone of Light



Job Name: _____

Type: _____

Part #: _____

Notes: _____

EEXEL

Edgelit Aluminum Exit Sign



Illumination

- Ultra bright, energy efficient, long life Red or Green LEDs.
- UV-stabilized ultra-clear acrylic edgelit panel provides consistent, uniform illumination.
- Double face utilizes factory installed silver or white mylar background panel.

Electrical

- Dual 120/277 voltage standard.
- Charge rate power "ON" LED indicator light and push-to-test switch for mandated code compliance testing.
- 4.8V long life, maintenance-free, rechargeable NiCd battery (EM models only).
- Internal solid-state transfer switch automatically connects the internal battery to LED board for minimum 90-minute emergency illumination.
- Fully automatic solid-state, two rate charger initiates battery charging to recharge a discharged battery in 24 hours.

Mounting

- Aluminum mounting canopy included for top, end or back mount.

Housing

- Premium-grade, extruded aluminum housing (also available in optional black or white powder-coated finishes).
- Self-adhesive Chevron appliques and guide template provided for directional indication.

Ordering Information

- 1 With single face only.
- 2 Available only with AC units.
- 3 Available only with EM units .
- 4 Not available with SDT.



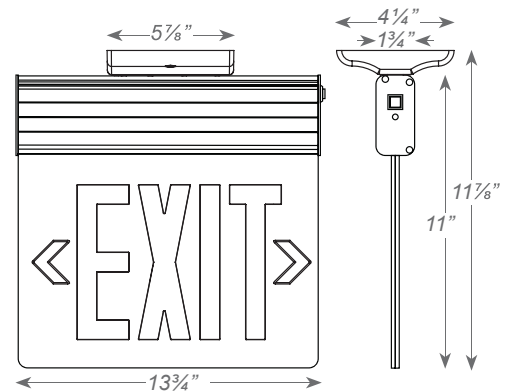
Options

- 2C-120V/2C-277V: Voltage-specific dual circuit option on the AC-only unit enables it to be connected to two different supplies at the same time.
- SDT: Self-diagnostic feature performs monthly, biannual, and annual tests to ensure reliable operation and meets electrical and life safety codes.
- USA: Substantial transformation assembly in the U.S. complies with "Assembled in the USA" under the Buy American Act.
- SPV: UL Listed for 208/220/240 Volt, 50/60Hz.
- Custom: Signs available with requested 'special' wording.

Warranty/ Listing

- Five year warranty on all electronics and housing. Battery prorated for five years.
- Meets UL924, NFPA 101 Life Safety Code, NEC, OSHA, Local and State Codes.
- UL Listed for damp locations (0°C – 50°C).
- Certified to CEC under Title 20 Regulations.

Dimensions



Product Number: EEXEL NF: LC: FP: HC: B: O:

Model	No. of Faces	Letter Color	Face Panel	Housing Color	Battery	Options
EEXEL	1	Single Face	R Red	C Clear ¹	W White	(blank) AC-Only
	2	Double Face	G Green	M Mirror	B Black	EM Battery Backup
				W White	A Aluminum	
						2C-120 Dual Circuit With 120V Input ²
						2C-277 Dual Circuit With 277V Input ²
						SDT Self-Diagnostics ³
						USA Assembled In
						SPV 208/220/240 Volt, 50/60Hz ⁴
						CUSTOM Custom Wording

PGAS-2 LED Specifications



Project Name:

Catalog Number:

Type:

The **PGAS-2 LED** luminaire from Visionaire combines contemporary design with new LED technology; while maintaining a traditional fixture image. The LED performance and Life are maximized by the unique integral aluminum heat sink. It is an ideal replacement for the high-maintenance fluorescent or HID fixtures of yesterday.

The LED housing is cast aluminum with internal heat sink for maximum heat dissipation; with 16 or 32 LEDs. The cast aluminum driver compartment allows the driver to operate cooler for long life.

Three optical distribution patterns are available. Choose between 3000, 4000 or 5000 Kelvin temperature of the LED's.

A durable polyester powder coat finish is guaranteed for five years; and is available in standard or custom colors.

The **PGAS-2 LED** series is an exceptional choice for all wall mount applications.

Ordering Information

MODEL	OPTICS	SOURCE	CURRENT	KELVIN	VOLTAGE	MOUNTING	FINISH	OPTIONS	OPTIONS
PGAS-2	T2 Type 2	16LC	3 350mA	3K 3000K	UNV 120-277V	WM Wall Mount	BZ Bronze	PC-120 Button Type Photocell	EBPL Emergency Battery Pack 120V-277V Only
	T3 Type 3	32LC	5 530mA	4K 4000K	8 347V		BK Black	PC-208 Button Type Photocell	VWC Visionaire Wireless Controls Consult Factory
	T4 Type 4		7 700mA	5K 5000K	5 480V		SBK Smooth Black	PC-240 Button Type Photocell	
							WH White	PC-277 Button Type Photocell	BP Back Plate
							SWH Smooth White		
							GP Graphite	WSC-8 Motion Sensor 8' Mounting Height	
							GY Grey		
							SL Silver Metallic	WSC-20 Motion Sensor 9-20' Mounting Height	
							CC Custom Color	WSC-40 Motion Sensor 21-40' Mounting Height	

*WSC options will require (1) FSIR 100 remote for programming

Housing

Heavy duty cast aluminum housing with internal heat sink for maximum heat dissipation. Silicone gasket is used for weather tight operation.

Mounting

A Wall Mount bracket can be secured directly to a 4"-5" recessed junction box.

Thermal Management

The PGAS series provides excellent thermal management by mounting the LEDs to the substantial heat sink within the housing. This enables the Luminaire to withstand higher ambient temperatures and driver currents without degrading LED life.

Optical System

- The highest lumen output LEDs are utilized. High-performance acrylic optics feature industry leading Type II, III, and IV optical distributions. Acrylic optics are impact-resistant and rated to 94 percent translucence.
- L70 life of our LEDs is rated over 100,000 hours (for 700 mA), The optical system qualifies as IES full cutoff to restrict light trespass, glare and light pollution for neighborhood-friendly lighting.
- CRI values are 70.

Quali-Guard® Finish

The finish is a Quali-Guard® textured, chemically pretreated through a multiple-stage washer, electrostatically applied, thermoset polyester powder coat finish, with a minimum of 3-5 millimeter thickness. Finish is oven-baked at 400° F to promote maximum adherence and finish hardness.

- All finishes are available in standard and custom colors.
- Finish is guaranteed for five (5) years.

Electrical Assembly

The PGAS-2 LED series is supplied with a choice of 350, 530 or 700 high-performance LED drivers that accept 120v thru 480v, 50 Hz to 60 Hz, input.

- Power factor of 90%.
- Rated for -40°C operations.
- 10 kV surge protector supplied as standard.

Warranty

Five (5) year Limited Warranty on electrical components, Five (5) year on finish. For full warranty information, please visit visionairelighting.com.

Options

- Button Style Photocell
- Watt Stopper FSP-211
- Back Plate
- Emergency Battery Pack
- Wireless Control

Listings

- PGAS-2 is cUL listed, suitable for wet locations.
- IP66 Rated
- Powder Coated Tough™
- DLC Listed
- Pangealink



DesignLights Consortium (DLC) qualified Product. Some configurations of this product family may not be DesignLights Consortium (DLC) listed, please refer to the DLC qualified products list to confirm listed configurations. <http://www.designlights.org/>
3000K must be selected for IDA certification.
Fixed mount must be selected for IDA dark sky certification.

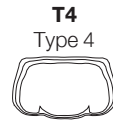
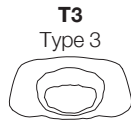
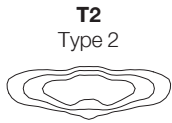
PGAS-2 - Electrical Load (A)							
Ordering Nomenclature	System Watts	120V	208V	240V	277V	347V	480V
PGAS-2-T3-16LC-350MA	18	0.14	0.08	0.07	0.06	0.05	0.04
PGAS-2-T3-16LC-530MA	26	0.22	0.12	0.11	0.09	0.07	0.05
PGAS-2-T3-16LC-700MA	37	0.28	0.16	0.14	0.12	0.10	0.07
PGAS-2-T3-32LC-350MA	34	0.28	0.16	0.14	0.12	0.10	0.07
PGAS-2-T3-32LC-530MA	53	0.43	0.25	0.22	0.19	0.15	0.11
PGAS-2-T3-32LC-700MA	70	0.58	0.33	0.29	0.25	0.20	0.14

Motion Sensor Default Setting									
FSP - 211	High Mode	Low Mode	Time Delay	Cut Off Delay	Sensitivity	Hold Off Setpoint	Photocell On/Off	Ramp Up Time	Fade Down Time
WSC - Default	10V	1V	5 Minutes	1 Hour	Max	Disabled	Disabled	Disabled	Disabled
WSC Range	0-10V	0-9.8V	5-30 Minutes	1-5 Hours	Low, Med, Max	1-250FC	1-250FC	1-60 Dec	1-60 Dec

* Settings can be field modified with the FSIR-100 Programming remote

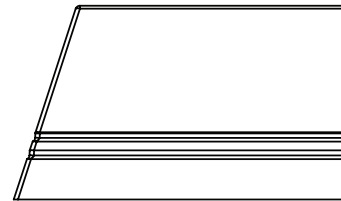
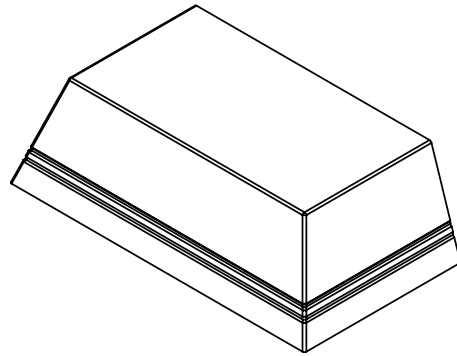
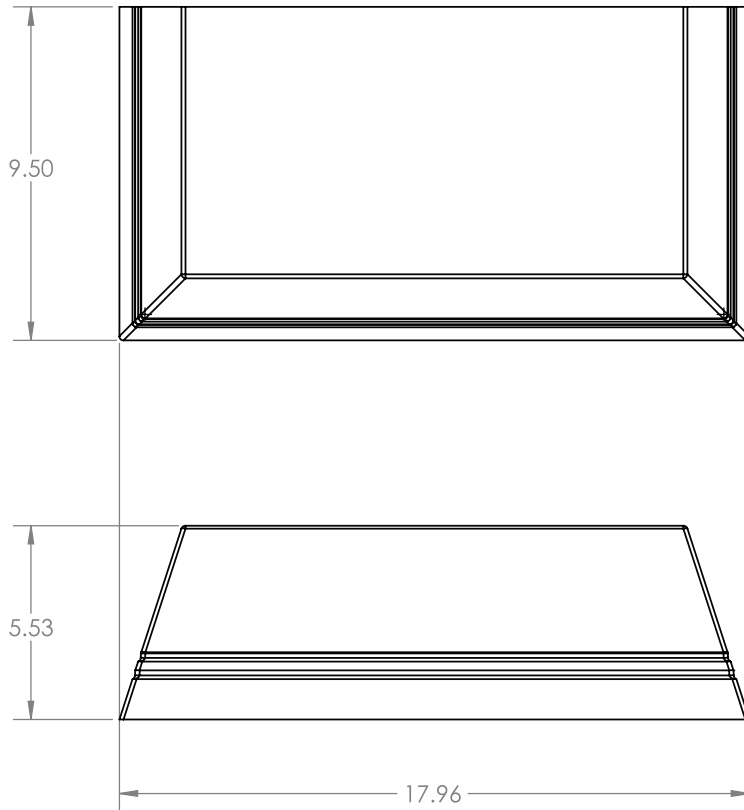
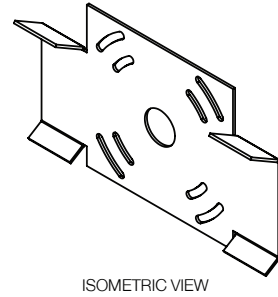
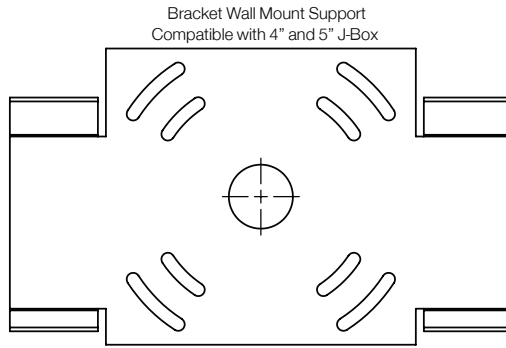
PGAS-2 LED Specifications

Photometric Optical Summary



Dimensions

Width:	PGAS-2 17.96"
Height:	PGAS-2 5.53"
Depth:	PGAS-2 9.50"
Weight:	20 LBS



PGAS-2 3K LUMEN DATA						PGAS-2 3K LUMEN DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	2261	2271	2210	17	32	350	4448	4359	4380	34																		
	530	3103	3117	3033	26		530	6280	6155	6185	52																		
	700	4009	4027	3919	34		700	7810	7654	7691	69																		
PGAS-2 4K LUMEN DATA						PGAS-2 4K LUMEN DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	2235	2245	2185	17	32	350	4541	4450	4472	34																		
	530	3068	3082	2999	26		530	6253	6128	6158	52																		
	700	3964	3982	3875	34		700	7645	7492	7528	69																		
PGAS-2 5K LUMEN DATA						PGAS-2 5K LUMEN DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	2191	2201	2142	17	32	350	4437	4348	4369	34																		
	530	3007	3020	2939	26		530	6220	6096	6125	52																		
	700	3885	3903	3798	34		700	7556	7405	7441	69																		
PGAS-2 3K LPW DATA						PGAS-2 3K LPW DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	133	134	130	17	32	350	131	128	129	34																		
	530	119	120	117	26		530	121	118	119	52																		
	700	118	118	115	34		700	113	111	111	69																		
PGAS-2 4K LPW DATA						PGAS-2 4K LPW DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	131	132	129	17	32	350	134	131	132	34																		
	530	118	119	115	26		530	120	118	118	52																		
	700	117	117	114	34		700	111	109	109	69																		
PGAS-2 5K LPW DATA						PGAS-2 5K LPW DATA																							
# LEDs	mA	T2	T3	T4	Power (W)	# LEDs	mA	T2	T3	T4	Power (W)																		
16	350	129	129	126	17	32	350	130	128	128	34																		
	530	116	116	113	26		530	120	117	118	52																		
	700	114	115	112	34		700	110	107	108	69																		
PGAS-2 3K BUG DATA						PGAS-2 3K BUG DATA																							
# LEDs	mA	T2			T3			T4			Power (W)	# LEDs	mA	T2			T3			T4			Power (W)						
16	350	B	U	G	B	U	G	B	U	G	B	U	G	17	32	350	B	U	G	B	U	G	B	U	G	B	U	G	34
	530	1	0	1	1	0	1	1	0	1	1	0	1	26		530	1	0	2	2	0	2	2	0	2	2	0	2	52
	700	1	0	1	1	0	1	1	0	1	1	0	1	34		700	2	0	3	2	0	2	2	0	2	2	0	2	69
PGAS-2 4K BUG DATA						PGAS-2 4K BUG DATA																							
# LEDs	mA	T2			T3			T4			Power (W)	# LEDs	mA	T2			T3			T4			Power (W)						
16	350	B	U	G	B	U	G	B	U	G	17	32	350	B	U	G	B	U	G	B	U	G	34						
	530	1	0	1	1	0	1	1	0	1	26		530	1	0	2	2	0	2	2	0	2	52						
	700	1	0	1	1	0	1	1	0	1	34		700	2	0	2	2	0	2	2	0	2	69						
PGAS-2 5K BUG DATA						PGAS-2 5K BUG DATA																							
# LEDs	mA	T2			T3			T4			Power (W)	# LEDs	mA	T2			T3			T4			Power (W)						
16	350	B	U	G	B	U	G	B	U	G	17	32	350	B	U	G	B	U	G	B	U	G	34						
	530	1	0	1	1	0	1	1	0	1	26		530	1	0	2	2	0	2	2	0	2	52						
	700	1	0	1	1	0	1	1	0	1	34		700	2	0	2	2	0	2	2	0	2	69						

FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured in place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

OPTICS — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080" thick). Miro 5 aluminum reflector used to achieve wide distribution.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Standard 0-10V dimming. Integral 6kV/3kA surge protection, tested in accordance to IEEE/ANSI standards. >L88 at 60,000 hours (see chart on page 3).

INSTALLATION — Stainless steel surface mount brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2" - 3/4" KO. When wall mounted the product will be rated for damp location only.

LISTINGS — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F(40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. VAP LED is NSF Splash Zone rated when suspended or ceiling mounted. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

For installed Rough Service Product(s), Acuity warrants that, for the lifetime of the product(s), the polycarbonate lens and/or polycarbonate housing will withstand breakage resulting from occasional physical abuse and rough handling (the "Rough Service Warranty"), not withstanding the vandalism exclusion set forth at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Catalog Number
Notes
Type

ARCHWAY™
PASSAGE™

Rough Service Fixture

VAP LED

CEILING/
SUSPEND MOUNT



Specifications

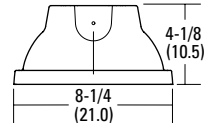
Length: 54-3/4 (139.1)

Width: 8-1/4 (21.0)

Depth: 4-1/8 (10.5)

Weight: 13.5 lbs. (5.9 kg)

All dimensions are shown in inches (centimeters) unless otherwise noted.



A+ Capable Luminaire

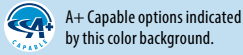
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

VAP Linear Rough Service, LED



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: VAP 4000LM FST MD MVOLT GZ10 40K 80CRI

VAP									
Series	Nominal lumens	Diffuser	Distribution	Voltage	Driver	Color temperature	CRI		
VAP	4000LM 4,000 lumens	FST Frosted polycarbonate lens	MD Medium	MVOLT 120/277V	GZ10 0-10V dimming	30K 3000K	80CRI	80 CRI	
	6000LM 6,000 lumens	PCL Clear polycarbonate lens	WD Wide	120 120V		35K 3500K	90CRI	90 CRI	
	8000LM 8,000 lumens ¹			277 277V		40K 4000K			
	12000LM 12,000 lumens ^{1,2,3}			HVOLT 357/480V		50K 5000K			
	15000LM 15,000 lumens ^{1,3,4,5}			347 347V					
				480 480V					

Options			
BSL520	Bodine® emergency LED battery pack for -20°C and up, CA Title 20 Noncompliant ^{4,5,6,7}	STSL	Stainless steel tamper resistant latches
E15WCP	Emergency battery pack, 15W constant power, Certified in CA Title 20 MAEDBS ^{4,6,7,9}	QMB	Quick-mount ceiling bracket
WLF	Wet location fitting (two outboard, top) ¹⁰	CMB	Chain-mount suspension bracket
WLFIN	Wet location fitting (two inboard, top) ¹⁰	JSB	Junction box snap-bracket
WLFEND	Wet location fitting (one end)	LSC	Lens safety clip
WLFEND2	Wet location fitting (both ends) ^{10,11}	DL	Damp location
CS89	6' white cord, 16/3, no plug, wet location ¹²	BGTD	Bodine generator transformer device ^{4,7,8,13}
CS88	6' Brad Harrison 16/3 cord and straight blade plug set ⁸	SF	Single fuse (120, 277, 347V)
CS88L12	12' Brad Harrison 16/3 cord and straight blade plug set ⁸	DF	Double fuse (208, 240, 480V)
		SPD	Surge protection device ¹⁴
			Individual Controls: ^{7,8,15}
			MSI10NWL Low mount 360 integral motion sensor, wet location, On/Off operation
			MSI102L3VWL Low mount 360 integral motion sensor, wet location, High/Low operation (bi-level)
			MSI10NWL DSCNWL Low mount 360 integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight
			Xpoint Wireless: ¹⁵
			XAD XPoint™ wireless controller, 0-10V dimming ^{4,7,13}
			MSI10XAWL10M DSCXAWL XPoint™ wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight ⁴
			nLight Air2:
			NLTAIR2 RSBOR10 nLight AIR generation 2 enabled 360 low mount motion sensor ^{7,8,14}

Accessories: Order as separate catalog number. (Ships separately)			
VAP5MB	Surface-mount bracket	RK1 T20BIT	Hex base driver bit, Torx T20 Tamper resistant screws with center reject pin
VAPQMB	Quick-mount ceiling bracket	RK1 T20DRV	Torx T20 screwdriver for use with tamper resistant screws with center reject pin
VAPCMB	Chain-mount bracket		
VAPJSB	Junction box snap bracket		
HC36	Wire hook and 36" chain set ^{16,17}		

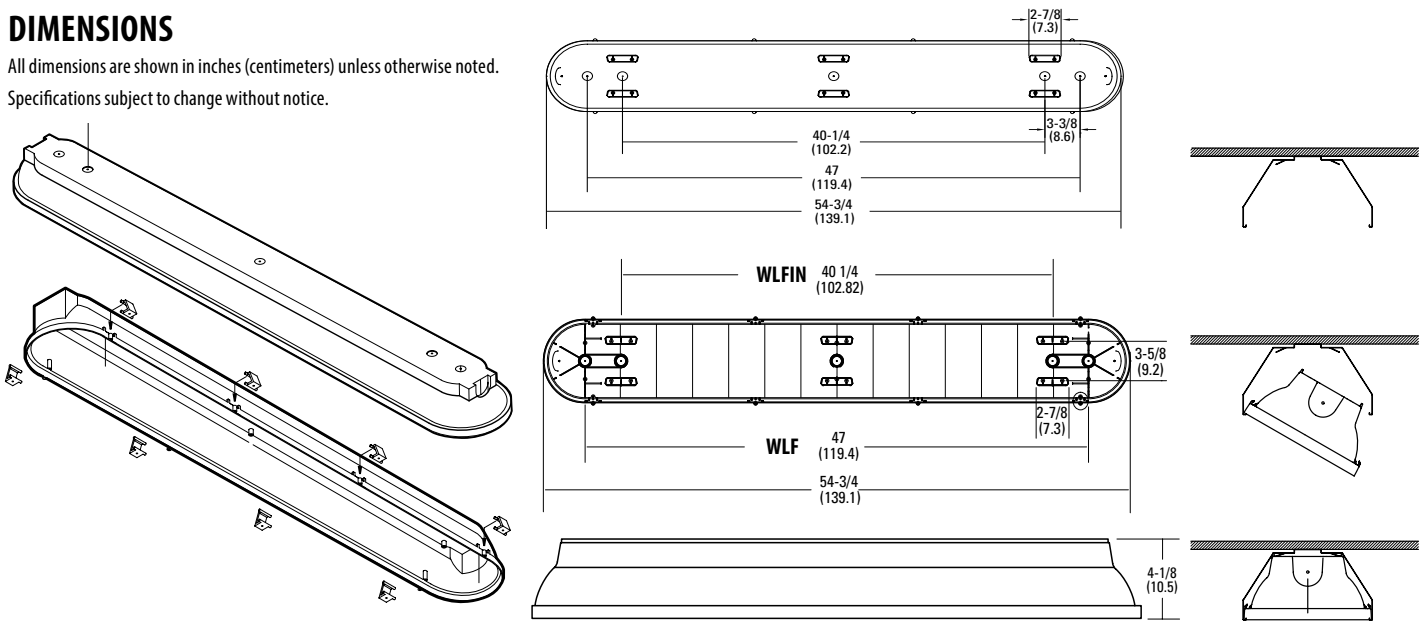
Notes

- Not available with BSL520 battery option
- When used with XAD, HVOLT, 347 and 480, maximum ambient temperature is 35°C.
- Not available with E15WCP.
- Not available with HVOLT, 347 and 480.
- Maximum ambient temperature 35°C.
- Not available with XPoint options.
- Not available with SPD as the SPD is standard with option.
- Must specify voltage.
- Minimum ambient temperature is 0°C. Title 20 compliant. Maximum mounting height is 25ft.
- Utilizes 5/8" long NPT threaded hub.
- Not available with cord, sensor or photocell options.
- Fixtures ship with black 4-conductor cords when BSL520 options are ordered.
- If used with 8000LM, 12000LM or 15000LM, maximum ambient temperature is 35°C.
- For additional protection up to 10kV.
- Not available with multiple control options - other MSE or Xpoint.
- Requires CMB (chain mount bracket) option.
- For stainless steel, specify STS (ex. HC36 STS).

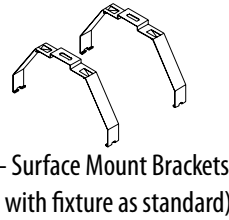
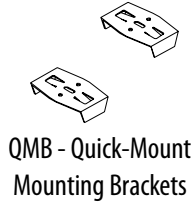
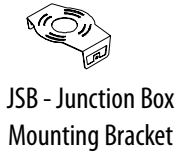
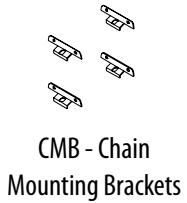
VAP Linear Rough Service, LED

DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted. Specifications subject to change without notice.



MOUNTING ACCESSORIES



ARCHWAY™ PASSAGE™ LED Specification Matrix											
Nominal lumens	Distribution	Initial delivered lumens @ 80CRI with clear polycarbonate lens				Initial delivered lumens @ 80CRI with frosted polycarbonate lens				Wattage @120V	Comparable source
		30K	35K	40K	50K	30K	35K	40K	50K		
4000LM	MD	4295	4446	4517	4647	3695	3777	3887	3998	33	2-lamp 32W T8, 1-lamp 54W T5, 70W HID
	WD	4208	4357	4426	4553	3623	3750	3810	3919		
6000LM	MD	6013	6226	6325	6506	5174	5357	5443	5598	49	3-lamp 32W T8, 2-lamp 54W T5, 100W HID
	WD	5892	6100	6198	6375	5072	5251	5335	5488		
8000LM	MD	8348	8643	8781	9032	7183	7437	7556	7772	67	4-lamp 32W T8, 2-lamp 54W T5, 150W HID
	WD	8180	8469	8604	8850	7042	7290	7407	7618		
12000LM	MD	11742	12156	12350	12703	10103	10460	10627	10931	99	6-lamp 32W T8, 3-lamp 54W T5, 250W HID
	WD	11505	11911	12101	12447	9904	10254	10417	10715		
15000LM	MD	14519	15031	15271	15708	12493	12934	13140	13516	115	6-lamp 32W T8, 4-lamp 54W T5, 250W HID
	WD	14226	14728	14963	15391	12246	12679	12881	13249		

Lumen Maintenance @ 25C

Operating Hours	0	10,000	20,000	25,000	35,000	50,000	60,000	75,000	100,000
4000LM	1	0.980	0.973	0.969	0.962	0.952	0.95	0.935	0.919
6000LM	1	0.972	0.962	0.957	0.950	0.933	0.923	0.909	0.886
8000LM	1	0.962	0.947	0.94	0.925	0.903	0.889	0.868	0.834
12000LM	1	0.970	0.960	0.952	0.940	0.922	0.910	0.900	0.865
15000LM	1	0.969	0.956	0.949	0.936	0.917	0.905	0.886	0.857

OPTIONS AND ACCESSORIES

The DMW2 Series fixture offers numerous options for almost every electrical and optical component, including a long list of field-installable accessories.

rSBOR/SBOR – Fixture Mount Sensor (see www.sensorswitch.com for additional information)

- 360° coverage
- On/Off dim
- Photocell optional
- IP66 rated
- Photocell and 0-10VDC dimming options.

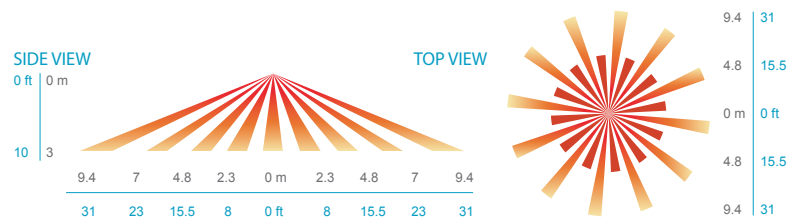


Fixture sensor nomenclature	RSBOR/SBOR sensor nomenclature
For shortest lead times use one of the following SBOR configurations	
NLTAIR2 RSBOR10	RSBOR 10 EB4 WH G2
MSI10NWL	SBOR 10 OEX EB4 WH
MSI102L3VWL	SBOR 10 OEX D EB4 WH 3V
MSI10NWL DSCNWL	SBOR 10 OEX P EB4 WH

COVERAGE PATTERNS

PARKING GARAGE / LOW MOUNT APPLICATIONS

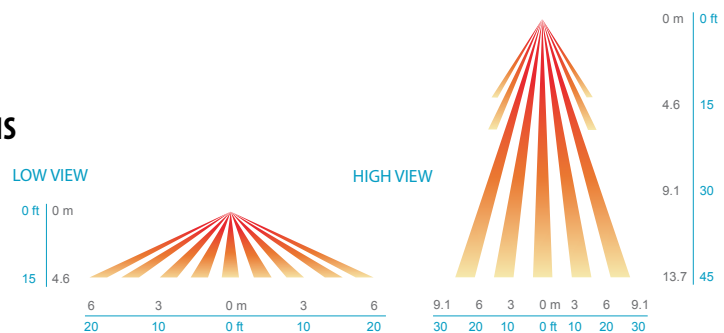
In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360° pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270° of coverage (90° is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.



Coverage Pattern of Low Mount Lens Option (SBOR 10)

SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270° of coverage (90° is blocked by the pole).



Coverage Pattern of High Mount Lens Option (SBOR 6)



Gardco Gullwing LED luminaires combine LED performance excellence and advanced Gardco LED thermal management technology with the distinct Gullwing style to provide outdoor area lighting that is both energy efficient and aesthetically pleasing.

Project: _____
 Location: _____
 Cat.No: _____
 Type: _____
 Lamps: _____ Qty: _____
 Notes: _____

Ordering guide

Example: GL18-APD-1-4-80LA-4853-NW-120-BRP-LF

Prefix	Controls	Mounting	Optical System ⁶	Wattage	LED Color	Voltage	Finish	Options
GL18	<input type="text"/>	1	5	160LA-481A	NW	UNV	<input type="text"/>	<input type="text"/>
GL18 18" Gullwing LED Luminaire	— Gullwing Standard Luminaire DIM 0-10V Dimming APD ¹ Automatic Profile Dimming MRI ¹ Motion Response at 50% Low (luminaire mounted sensor) APD-MRI ¹ APD with Motion Response Override (luminaire mounted sensor) FAWS ³ Field Adjustable Wattage Selector Wireless systems (Remote wireless controller available.) LLC2 ^{1,5} #2 lens for 8' mounting heights LLC3 ^{1,5} #3 lens for 9-20' mounting heights LLC7 ^{1,5} #7 lens for 21-40' mounting heights Network system (SiteWise) SW Integral module ³ SW-MRI3 luminaire mounted sensor option Type 3 SW-MRI7 luminaire mounted sensor option Type 7	1 Single 2 2 @ 180° 2@90 2 @ 90° 3 3@90° 3@120 3@120° 4 4@90° W Wall Mount, Recessed J-Box WS Wall Mount, Surface Conduit	2 Type 2 2-90 Type 2@90° 2-270 Type 2@270° 3 Type 3 3-90 Type 3@90° 3-270 Type 3@270° 4 Type 4 4-90 Type 4@90° 4-270 Type 4@270° 5 Type 5	50LA-4835 48 LEDs, 350mA 80LA-4853 48 LEDs, 530mA 105LA-4870 48 LEDs, 700mA 160LA-481A 48 LEDs, 1A 180LA-6490 64 LEDs, 900mA 210LA-641A 64 LEDs, 1A 200LA-9670 96 LEDs, 700mA 230LA-9680 96 LEDs, 800mA 265LA-9690 96 LEDs, 900 mA 310LA-961A 96 LEDs, 1A	NW Neutral White 4000K, 70 min. CRI CW Cool White 5700K, 70 min. CRI WW Warm White 3000K, 70 min. CRI	120 208 240 277 347 480 UNV (120-277V) HVU (347-480V)	BLP Black Paint WP White Paint BRP Bronze Paint NP Natural Aluminum Paint OC Optional Color <i>Specify optional color or RAL ex: OC-LGP or OC-RAL7024.</i> SC Special Color Specify. <i>Must supply color chip. Requires factory quote.</i>	F Fusing LF In-Line/In-Pole Fusing PC ^{4,5,7} Photocontrol and Receptacle (Includes PCR5) PCR5 ^{4,5,7,8} Photocell Receptacle only with 2 dimming connections PCR7 ^{4,5,8,9} Photocell Receptacle only with 2 dimming and 2 auxiliary connections HS External Houseside Shield IS Internal Houseside Shield (types 2, 3, 4 only) CLR ⁶ Clear Glass Lens (reduces performance) RPA1 3" Round Pole Adapter Required for 3" O.D. round or tapered round poles where top O.D. is less than 4" RPA2 4" and 5" Round Pole Adapter Required for 4" - 5" O.D. round poles MA Mast Arm Fitter - Mounts to a 2-3/8" O.D. mast arm. TR1 ¹⁰ Single Transition TR2 ¹⁰ Twin Transition PTF2 ¹¹ Pole Top Fitter 2 3/8" - 3" Dia. Tenon PTF3 ¹¹ Pole Top Fitter 3" - 3 1/2" Dia. Tenon PTF4 ¹¹ Pole Top Fitter 3 1/2" - 4" Dia. Tenon

- Available 120-277V only.
- Available 120 or 277V only.
- Not available with other control options.
- Not available in 480V.
- LLC2/LLC3/LLC7 wireless system not configurable with PC/PCR5/PCR7 Options.
- Luminaire door frame and optic assembly provided standard without glass lens. Specify CLR option for clear glass lens.
- Works with 3-pin or 5-pin NEMA photocell/dimming device.
- If ordered with DIM, APD, MRI, APD-MRI, dimming will not be connected to NEMA receptacle.
- Works with 3-pin or 5-pin NEMA photocell/dimming device and auxiliary connections are not connected (for future use only).
- Mounts to a 2-3/8" Top Tenon. Specify a round pole with a 4.50" O.D. for a smooth transition.
- Not available in 120° mounting configurations.



GL18 Gullwing LED luminaire

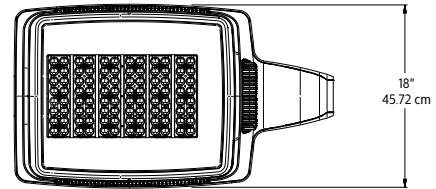
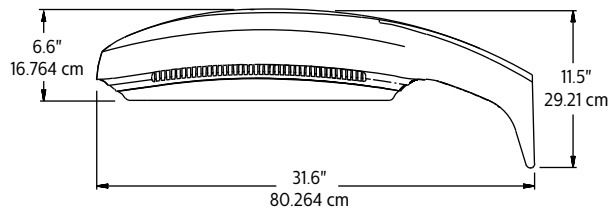
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Ordering guide

Prefix	Controls	Optical System ⁶	Wattage	LED Color	Voltage	Finish	Options
GL18-RK 18" Gullwing LED Retrofit Kit	DIM with 0-10v Dimming APD ¹ with Automatic Profile Dimming	2 Type 2 2-90 Type 2@90° 2-270 Type 2@270° 3 Type 3 3-90 Type 3@90° 3-270 Type 3@270° 4 Type 4 4-90 Type 4@90° 4-270 Type 4@270° 5 Type 5	50LA-4835 48 LEDs, 350mA 80LA-4853 48 LEDs, 530mA 105LA-4870 48 LEDs, 700mA 160LA-481A 48 LEDs, 1A 180LA-6490 64 LEDs, 900mA 210LA-641A 64 LEDs, 1A 200LA-9670 96 LEDs, 700mA 230LA-9680 96 LEDs, 800mA 265LA-9690 96 LEDs, 900 mA 310LA-961A 96 LEDs, 1A	NW Neutral White 4000K, 70 min. CRI CW Cool White 5700K, 70 min. CRI WW Warm White 3000K, 70 min. CRI	120 208 240 277 347 480 UNV (120-277V) HVU (347-480V)	BLP Black Paint WP White Paint BRP Bronze Paint NP Natural Aluminum Paint OC Optional Color <i>Specify optional color or RAL ex: OC-LGP or OC-RAL7024.</i> SC Special Color <i>Specify. Must supply color chip. Requires factory quote.</i>	IS Internal Houseside Shield (types 2, 3, 4 only)

1. Available 120-277V only.

Dimensions and EPA



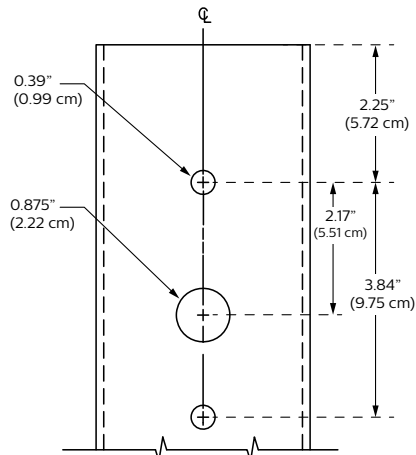
EPA Data

1	2	3-4
1.2 ft ²	2.4 ft ²	3.2 ft ²
.12 m ²	.24 m ²	.30 m ²

Approximate Weight Single Luminaire

40 lbs / 18.144 kg

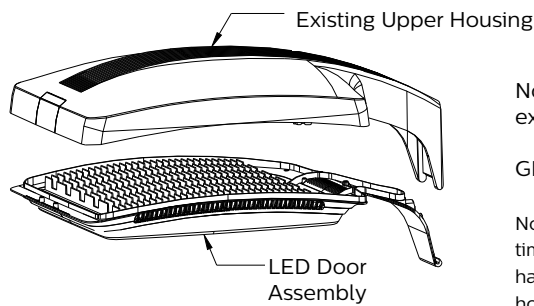
GL18 Drill Template



GL18 Gullwing LED luminaire

Large

GL18-RK LED Retrofit Kit



Note: Removal of all components of existing G18 Gullwing luminaires, except the upper housing, is required to perform a retrofit.

GL18-RK includes all necessary retrofit components.

Note: TGIC polyester powdercoat will fade somewhat in exterior environments over time. Once the retrofit kit is installed, there is a possibility that the upper housing may have faded to a point where there is a noticeable paint difference between the upper housing (existing) and the new retrofit kit door frame.

LED Wattage and Lumen Value - 3000K

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 2			Type 3		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-WW	48	350	50	3000K	6638	133	B2-U0-G1	6106	122	B1-U0-G2
GL18-x-80LA-4853-WW	48	530	80	3000K	9570	120	B2-U0-G1	8802	110	B2-U0-G2
GL18-x-105LA-4870-WW	48	700	105	3000K	12139	116	B3-U0-G2	11171	106	B2-U0-G2
GL18-x-160LA-481A-WW	48	1050	160	3000K	16471	103	B3-U0-G2	15142	94	B2-U0-G3
GL18-x-180LA-6490-WW	64	900	180	3000K	19022	106	B3-U0-G2	17846	99	B3-U0-G3
GL18-x-210LA-641A-WW	64	1050	208	3000K	21349	102	B3-U0-G2	20016	96	B3-U0-G3
GL18-x-200LA-9670-WW	96	700	200	3000K	23713	119	B3-U0-G2	21704	109	B3-U0-G3
GL18-x-230LA-9680-WW	96	800	230	3000K	26191	114	B3-U0-G2	23986	104	B3-U0-G4
GL18-x-265LA-9690-WW	96	900	265	3000K	28669	108	B4-U0-G3	26246	99	B3-U0-G4
GL18-x-310LA-961A-WW	96	1050	309	3000K	31366	101	B4-U0-G3	28705	93	B3-U0-G4

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 4			Type 5		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-WW	48	350	50	3000K	6300	126	B1-U0-G2	6628	133	B3-U0-G1
GL18-x-80LA-4853-WW	48	530	80	3000K	9083	114	B2-U0-G2	9555	119	B3-U0-G2
GL18-x-105LA-4870-WW	48	700	105	3000K	11521	110	B2-U0-G2	12121	115	B4-U0-G2
GL18-x-160LA-481A-WW	48	1050	160	3000K	15633	98	B2-U0-G3	16446	103	B4-U0-G2
GL18-x-180LA-6490-WW	64	900	180	3000K	17943	100	B3-U0-G3	19213	107	B4-U0-G2
GL18-x-210LA-641A-WW	64	1050	208	3000K	20139	97	B3-U0-G4	21564	104	B4-U0-G2
GL18-x-200LA-9670-WW	96	700	200	3000K	22136	111	B3-U0-G4	23847	119	B5-U0-G3
GL18-x-230LA-9680-WW	96	800	230	3000K	24449	106	B3-U0-G4	26339	115	B5-U0-G3
GL18-x-265LA-9690-WW	96	900	265	3000K	26762	101	B3-U0-G4	28830	109	B5-U0-G3
GL18-x-310LA-961A-WW	96	1050	309	3000K	29280	95	B3-U0-G4	31543	102	B5-U0-G3

LED Wattage and Lumen Value - 4000K

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 2			Type 3		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-NW	48	350	50	4000K	7376	148	B2-U0-G1	6784	136	B1-U0-G2
GL18-x-80LA-4853-NW	48	530	80	4000K	10,633	133	B2-U0-G2	9780	122	B2-U0-G2
GL18-x-105LA-4870-NW	48	700	105	4000K	13,488	128	B3-U0-G2	12412	118	B2-U0-G2
GL18-x-160LA-481A-NW	48	1050	160	4000K	18,302	114	B3-U0-G2	16824	105	B3-U0-G3
GL18-x-180LA-6490-NW	64	900	180	4000K	21,135	117	B3-U0-G2	19829	110	B3-U0-G3
GL18-x-210LA-641A-NW	64	1050	208	4000K	23,721	114	B3-U0-G2	22240	107	B3-U0-G4
GL18-x-200LA-9670-NW	96	700	200	4000K	26,347	132	B3-U0-G2	24115	121	B3-U0-G4
GL18-x-230LA-9680-NW	96	800	230	4000K	29,101	127	B4-U0-G3	26651	116	B3-U0-G4
GL18-x-265LA-9690-NW	96	900	265	4000K	31,854	120	B4-U0-G3	29162	110	B3-U0-G4
GL18-x-310LA-961A-NW	96	1050	309	4000K	34,851	113	B4-U0-G3	31894	103	B3-U0-G4

GL18 Gullwing LED luminaire

Large

LED Wattage and Lumen Value - 4000K (continued)

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 4			Type 5		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-NW	48	350	50	4000K	7000	140	B1-U0-G2	7364	147	B3-U0-G1
GL18-x-80LA-4853-NW	48	530	80	4000K	10092	126	B2-U0-G2	10617	133	B4-U0-G2
GL18-x-105LA-4870-NW	48	700	105	4000K	12802	122	B2-U0-G2	13467	128	B4-U0-G2
GL18-x-160LA-481A-NW	48	1050	160	4000K	17370	108	B3-U0-G3	18273	114	B4-U0-G2
GL18-x-180LA-6490-NW	64	900	180	4000K	19937	111	B3-U0-G3	21348	119	B4-U0-G2
GL18-x-210LA-641A-NW	64	1050	208	4000K	22376	107	B3-U0-G4	23960	115	B5-U0-G3
GL18-x-200LA-9670-NW	96	700	200	4000K	24595	123	B3-U0-G4	26496	132	B5-U0-G3
GL18-x-230LA-9680-NW	96	800	230	4000K	27165	118	B3-U0-G4	29265	127	B5-U0-G3
GL18-x-265LA-9690-NW	96	900	265	4000K	29735	112	B3-U0-G4	32034	121	B5-U0-G3
GL18-x-310LA-961A-NW	96	1050	309	4000K	32533	105	B3-U0-G4	35048	113	B5-U0-G4

LED Wattage and Lumen Value - 5700K

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 2			Type 3		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-NW	48	350	50	5700K	6638	133	B2-U0-G1	6106	122	B1-U0-G2
GL18-x-80LA-4853-NW	48	530	80	5700K	9570	120	B2-U0-G1	8802	110	B2-U0-G2
GL18-x-105LA-4870-NW	48	700	105	5700K	12139	116	B3-U0-G2	11171	106	B2-U0-G2
GL18-x-160LA-481A-NW	48	1050	160	5700K	16471	103	B3-U0-G2	15142	94	B2-U0-G3
GL18-x-180LA-6490-NW	64	900	180	5700K	19022	106	B3-U0-G2	17846	99	B3-U0-G3
GL18-x-210LA-641A-NW	64	1050	208	5700K	21349	102	B3-U0-G2	20016	96	B3-U0-G3
GL18-x-200LA-9670-NW	96	700	200	5700K	23713	119	B3-U0-G2	21704	109	B3-U0-G3
GL18-x-230LA-9680-NW	96	800	230	5700K	26191	114	B3-U0-G2	23986	104	B3-U0-G4
GL18-x-265LA-9690-NW	96	900	265	5700K	28669	108	B4-U0-G3	26246	99	B3-U0-G4
GL18-x-310LA-961A-NW	96	1050	309	5700K	31366	101	B4-U0-G3	28705	93	B3-U0-G4

Ordering Code	LED QTY	System Current (mA)	Average System Watts ¹⁵	Color Temp.	Type 4			Type 5		
					Lumen Output	Efficacy (Lm/W)	BUG Rating	Lumen Output	Efficacy (Lm/W)	BUG Rating
GL18-x-50LA-4835-NW	48	350	50	5700K	6300	126	B1-U0-G2	6628	133	B3-U0-G1
GL18-x-80LA-4853-NW	48	530	80	5700K	9083	114	B2-U0-G2	9555	119	B3-U0-G2
GL18-x-105LA-4870-NW	48	700	105	5700K	11521	110	B2-U0-G2	12121	115	B4-U0-G2
GL18-x-160LA-481A-NW	48	1050	160	5700K	15633	98	B2-U0-G3	16446	103	B4-U0-G2
GL18-x-180LA-6490-NW	64	900	180	5700K	17943	100	B3-U0-G3	19213	107	B4-U0-G2
GL18-x-210LA-641A-NW	64	1050	208	5700K	20139	97	B3-U0-G4	21564	104	B4-U0-G2
GL18-x-200LA-9670-NW	96	700	200	5700K	22136	111	B3-U0-G4	23847	119	B5-U0-G3
GL18-x-230LA-9680-NW	96	800	230	5700K	24449	106	B3-U0-G4	26339	115	B5-U0-G3
GL18-x-265LA-9690-NW	96	900	265	5700K	26762	101	B3-U0-G4	28830	109	B5-U0-G3
GL18-x-310LA-961A-NW	96	1050	309	5700K	29280	95	B3-U0-G4	31543	102	B5-U0-G3

Values from photometric tests performed in accordance with IESNA LM-79 and are representative of the configurations shown. Actual performance may vary due to installation and environmental variables, LED and driver tolerances, and field measurement considerations. It is highly recommended to confirm performance with a photometric layout.
NOTE: Some data may be scaled based on tests of similar (but not identical) luminaires. Contact factory for configurations not shown.

Predicted lumen depreciation data:

Ambient Temperature °C	Driver mA	Calculated L ₇₀ Hours	L ₇₀ Per TM-21	Lumen Maintenance % @ 60,000 hours
25°C	up to 1050 mA	>100,000	>60,000	96%

Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions. L70 is the predicted time when LED performance depreciates to 70% of initial lumen output. Calculated per IESNA TM21-11. Published L70 hours limited to 6 times actual LED test hours

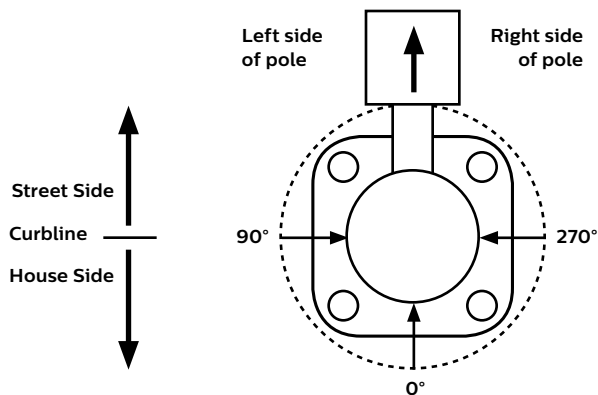
GL18 Gullwing LED luminaire

Large

Asymmetric Optical Orientation Information

Standard Optic Position

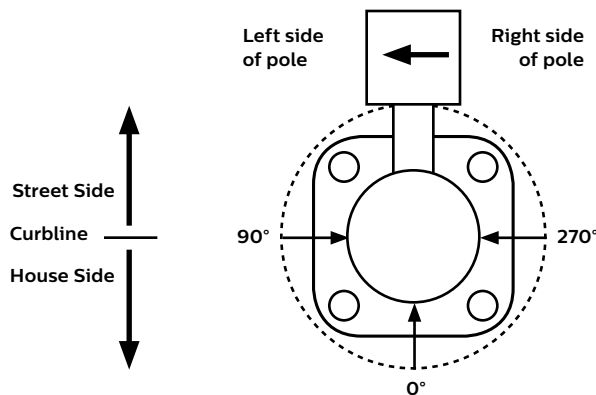
Luminaires ordered with asymmetric optical systems in the standard optic position will have the optical system oriented as shown below:



Note: The hand hole will normally be located on the pole at the 0° point.

Optic Rotated Left (90°) Optic Position

Luminaires ordered with asymmetric optical systems in the Optic Rotated Left (90°) optic position will have the optical system oriented as shown below:

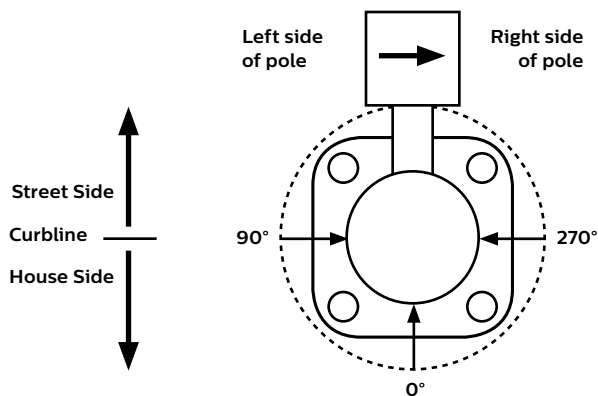


Note: The hand hole will normally be located on the pole at the 0° point.

Asymmetric Optical Orientation Information

Optic Rotated Right (270°) Optic Position:

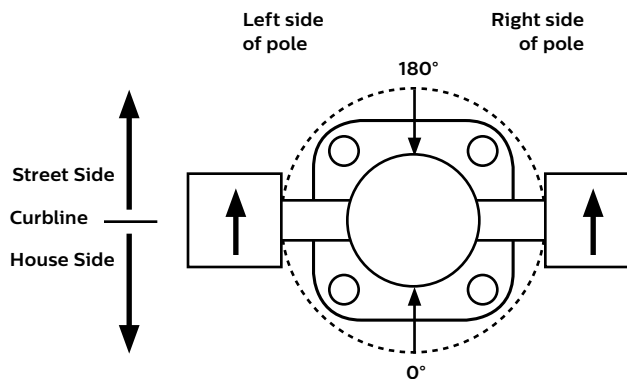
Luminaires ordered with asymmetric optical systems in the Optic Rotated Right (270°) optic position will have the optical system oriented as shown below:



Note: The hand hole will normally be located on the pole at the 0° point.

Twin Luminaire Assemblies With Rotated Optical Systems

Twin luminaire assemblies installed with rotated optical systems are an excellent way to direct light toward the interior of the site (Street Side) without additional equipment. It is important, however, that care be exercised to insure that luminaires are installed in the proper location.



Luminaires with Optic Rotated Right (270°) are installed on the LEFT Side of Pole

Luminaires with Optic Rotated Left (90°) are installed on the RIGHT Side of Pole

Note: The hand hole location will depend on the drilling configuration ordered for the pole.

GL18 Gullwing LED luminaire

Large

General Description

The Gardco Gullwing LED is defined by its high performance, sleek profile and rugged construction. Gullwing LED luminaires combine LED performance excellence and advanced Gardco LED thermal management technology with the distinct Gullwing style to provide outdoor area lighting that is both energy efficient and aesthetically pleasing.

Housing

A one-piece die cast aluminum housing mounts directly to a pole or wall without the need for a support arm. The low profile rounded form reduces the effective projected area of the luminaire to only 1.2 ft² /12 m².

IP Rating

Gullwing LED 18" optics are IP66 rated.

Thermal Management

The Gardco Gullwing LED provides a one piece die cast aluminum door with integral thermal radiation fins combined with lateral air ways, to provide the excellent thermal management so critical to long LED system life. GL18 is UL listed from -40 to 40°C ambient.

LED Optical System

LED arrays are set to achieve IES Type II, Type III, Type IV, Type V, available with internal shields for back light control. Type 2, 3, 4 optics can be factory set to 90 or 270° orientations. Individual LED arrays are replaceable. Luminaires feature high performance Class 1 LED systems.

GL18

Gardco Gullwing LED standard luminaire providing constant wattage and constant light output when power to the luminaire is energized.

GL18-DIM

Gardco Gullwing LED luminaire provided with 0-10V dimming for connection to a control system provided by others.

GL18-APD

Gardco Gullwing LED luminaire with Automatic Profile Dimming. Luminaire is provided with a programmable LED Driver, programmed to go to 50% power, 50% light output two (2) hours prior to night time mid-point and remain at 50% for six (6) hours after night time mid-point. Mid-point is continuously recalculated by the programmable LED Driver based on the average mid-point of the last two full night cycles. Short duration cycles, and power interruptions are ignored and do not affect the determination of mid-point.

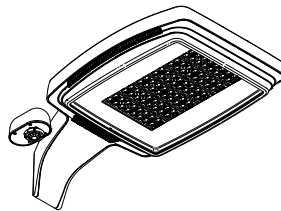
GL18-APD Dimming Profile:

100%	2 hours	6 hours	100%
	50%	50%	

Power On Mid Point Power Off

The GL18-APD offers many of the advantages of a sophisticated control system, including an average energy savings of at least 33% versus constant wattage, constant light output systems, without the need for a control system.

GL18-MRI (Luminaire mounted sensor)

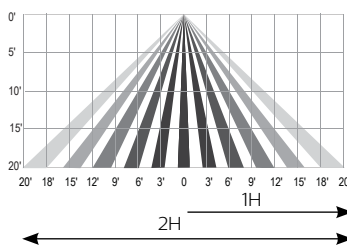


Luminaires with Motion Response and an integral motion sensor include a programmable LED driver and an outboarded programmable motion sensor attached to the luminaire arm. The motion sensor is set to a constant 50%. When motion is detected, the luminaire goes to 100%. The luminaire remains on high until no motion is detected for the motion sensor duration period, after which the luminaire returns to low. Duration period is factory set at 5 minutes. Available from 120V to 277V (UNIV) only.

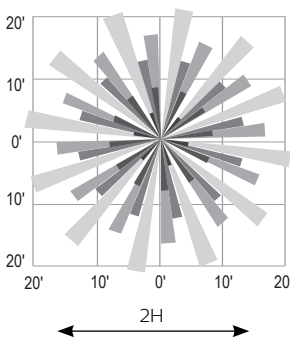
Luminaires include a passive infrared (PIR) motion sensor, WattStopper FSP-211 equipped with an FSP-L3 lens, capable of detecting motion within 20 feet of the sensor, 180° around the luminaire, when placed at a 20 foot mounting height, or mounted on a wall. Available from 120V to 277V input only. Motion sensor off state power is 0.0 watts.

The approximate motion sensor coverage pattern is as shown below.

Side Coverage Pattern



Top Coverage Pattern



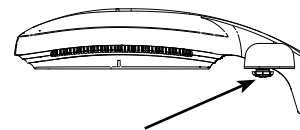
Distances are approximate.
H = height above ground

GL18-APD- MRI (Luminaire mounted sensor)

Luminaires with Integral Motion Sensor - GL18-APD- MRI: Luminaires with Automatic Profile Dimming and Motion Response Override combine the benefits of both automatic profile dimming and motion response. APD-MRI luminaires utilize a programmable LED driver. The luminaire will dim to 50% power, 50% light output, per the dimming profile shown for APD luminaires (see page 4). If motion is detected during the time that the luminaire is operating at 50%, the luminaire goes to 100% power and light output. The luminaire remains on high until no motion is detected for the duration period, after which the luminaire returns to low. Duration period is factory set at 15 minutes.

APD-MRI luminaires are available from 120V to 277V (UNIV) input voltages only.

APD-MRI luminaires use the identical motion sensor as MRI luminaires. See motion sensor details for GL18-MRI.



Approximate Sensor Placement on GL18-MRI and GL18-APD-MRI luminaires.

Sensor - Bottom View

Field Adjustable Wattage Selector (FAWS):

Luminaire equipped with the ability to manually adjust the wattage in the field to reduce total luminaire lumen output and light levels. Comes pre-set to the highest position at the lumen output selected. Use chart below to estimate reduction in lumen output desired. Cannot be used with other control options or motion response.

FAWS Position	Percentage of Typical Lumen Output
1	25%
2	50%
3	55%
4	65%
5	75%
6	80%
7	85%
8	90%
9	95%
10	100%

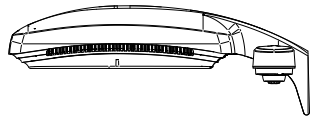
GL18 Gullwing LED luminaire

Large

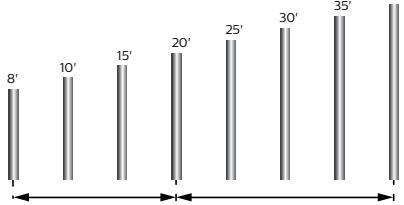
Luminaire configuration information – Gullwing LED with wireless system

GL18-LLC2/3/7 Luminaire Mounted Controller

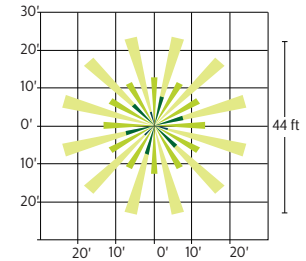
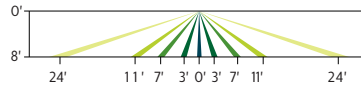
Wireless system attached to luminaire and includes radio, photocell and motion sensor with #2, 3, or 7 lens for 8-40' mounting heights.



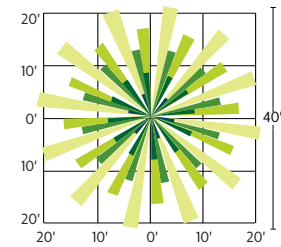
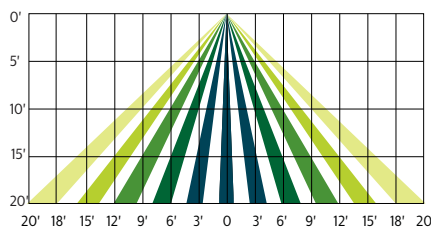
Recommended Sensor by Pole Height



LLC2 (for pole or remote mount only)



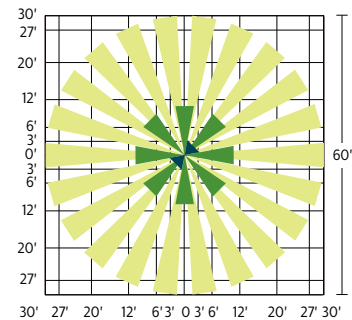
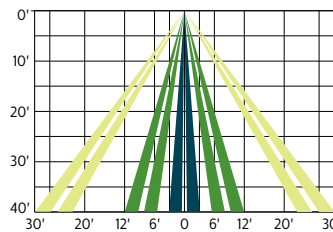
LLC3 (for luminaire, pole, or remote mount)



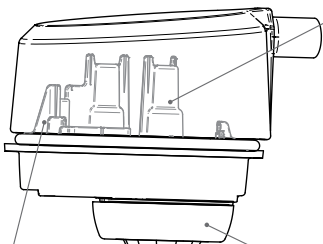
SW

SiteWise option is a fully integrated controller that connects to SiteWise system in order to offer a complete area lighting management system. The communication signal is based on patented central dimming technology. SiteWise delivers it deliver optimal energy savings using your site's existing cabling. No additional wiring required, installation and commissioning are simple. An intuitive, mobile app makes it easy for authorized users to set schedules to meet site specific lighting needs, local regulations, and energy codes.

LLCR7 (for luminaire, pole, or remote mount)



Controller



Photocell

- Ambient light photocell on every wireless radio that averages the light levels of up to 5 controllers for an accurate reading and optimal light harvesting activity.
- Reports ambient light readings to 1500 Fc.

Wireless Radio

- 1.8 Watts max (no load draw)
- Operating voltage 120-277 VAC RMS
- Communicates using the ZigBee protocol
- Carries out dimming commands from Gateway
- Reports ambient light readings to 1500 Ft-Cd
- Transmission Systems Operating within the band 2400-2483.5Mhz
- ROHS Compliant

Motion Response

- Detects motion through passive infrared sensing technology with three different lens configurations
- Motion sensor coverage can be adjusted from a narrow to a wide detection range, which helps reduce false triggers to further increase energy savings.
- Sensing profiles can be updated to adapt to activity levels in the environment, such as occupancy level, wind, and mounting height

GL18 Gullwing LED luminaire

Large

SiteWise network system

SiteWise system includes a controller fully integrated in the luminaire that enables the luminaires to communicate with a dimming signal transmitter cabinet located on site using patented central dimming technology. A locally accessible mobile app allows users to access the system and set functionalities such as ON/OFF, dimming levels and scheduling. SiteWise is available with motion response options in order to bring the light back to 100% when motion is detected. Additional functionalities are available such as communication with indoor lighting and connection to BMS systems.

Wireless System

Gullwing LED luminaires are available with optional wireless controllers ready to be connected to a Limelight system (sold by other). The system allows you to wirelessly manage the entire site, independent lighting groups or individual luminaires while on-site or remotely.

Based on a high density mesh network with an easy to use web-based portal, you can conveniently access, monitor and manage your lighting network remotely. Wireless controls can be combined with site and area, pedestrian, and parking garage luminaires as well, for a completely connected outdoor solution.

Electrical

Luminaires are equipped with an LED driver that accepts 120V through 277V, or 347V through 480V, 50hz to 60hz, input. Driver output is based on the LED wattage selected. Component-to-component wiring within the luminaire will carry no more than 80% of rated current and is listed by UL. Power factor is not less than 90%. Luminaire consumes 0.0 watts in the off state. All motion sensors utilized consume 0.0 watts in the off state. Surge protector standard. 10KA per ANSI/IEEE C62.41.2.

Finish

Each standard color luminaire receives a fade and abrasion resistant, electrostatically applied, thermally cured, triglycidal isocyanurate (TGIC) textured polyester powdercoat finish. Standard colors include bronze (BRP), black (BLP), white (WP), and 5 natural aluminum (NP). Consult factory for specs on optional or custom colors.

Labels

All luminaires bear UL or CUL (where applicable) Wet Location labels. Most GL18 configurations are qualified under Standard DesignLights Consortium® category. Consult DLC Qualified Products list to confirm your specific luminaire selection is approved.

Warranty

Gardco luminaires feature a 5 year limited warranty. Gardco LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays. LED Drivers also carry a 5 year limited warranty. Motion sensors are covered by warranty for 5 years by the motion sensor manufacturer. See signify.com/warranties for complete details and exclusions.

The information presented in this document is not intended as any commercial offer and does not form part of any quotation or contract.





KIM LIGHTING

VRB2C-LED Round Bollard

Dual Function, Vandal-Resistant, Concrete Shaft

revision 8/7/14 • kl_vrb2cled_spec.pdf

Type:
Job:
Catalog number:

Approvals:

VRB2C /	/	/	/	/
Fixture	Electrical Module	Top Cap Finish	Concrete Shaft Finish	Option

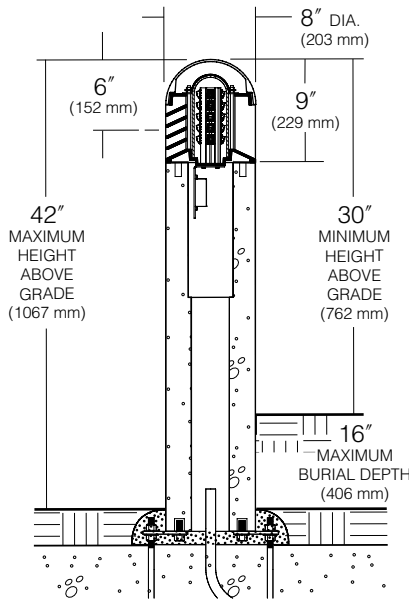
See page 2

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Page: 1 of 3

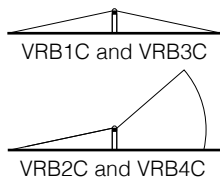
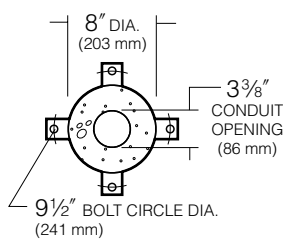
Specifications

VRB-LED Models
10 - 20 Diodes

VRB2C - Dual Function Luminaire (Concrete Shaft)
Maximum weight: 115 lb



BASE PLAN VRB CONCRETE SHAFT



Domed Top Cap: Aluminum die-cast secured to louvers by concealed allen screws in keyhole slots. For relamping access, allen screws shall not require complete removal.

Louvers: One-piece, sand-cast with horizontal and vertical blades. Horizontal louvers shall provide 210° of downlighting with source cutoff above horizontal. Vertical louvers shall provide 150° of non-cutoff lighting. Horizontal louver blades shall have a 1 3/4" depth with a 65° upward pitch from horizontal. Vertical louver blades shall have a 1 3/4" depth with a 30° spacing. Louver assembly shall be secured to shaft by four internal tie rods.

Lamp Enclosure: One-piece tempered molded glass with internal flutes and full gasketing at bottom edge.

Fixture Head: Allows flow-through ventilation around and above the lamp enclosure.

Electronic Module: All electrical components are either UL or ETL recognized, mounted on a single plate and factory prewired with quick disconnect plugs. Driver is rated for -40°F starting and has a 0-10V dimming interface for multi-level illumination options.

Optical Module: Each LED equipped with a directional optic for maximum beam angle projecting through louver stack spacings. LED boards to be mounted to an anodized inter-locking heat sink extrusion. (Type I) two 5-LED boards for a total of 10-LED. (Type III) three 5-LED boards for a total of 15-LED. (Type V) four 5-LED boards for a total of 20-LED. Available in 580nm Amber, 3000K, 4200K and 5100K color temperatures.

Anchor Bolts: Four 3/8" x 10" + 2" zinc plated L-hooks, each with two nuts, washers and a rigid pressed board template.

Material: Cement shall conform to current specifications for "Portland Cement." ASTM C150, Type I or II. Aggregates shall meet current requirements of "Specifications for Concrete Aggregates," ASTM C33. Water shall be clean and free from deleterious amounts of silt, oil, acids, alkalies or organic materials. Wire for reinforcement shall conform to ASTM A185. Steel for lugs and plates shall conform to ASTM A36, or A283 grade D.

Surface: Medium sand-blasted with anti-graffiti sealer. Available colors are: Charcoal, Brown, Natural Gray or White, integral in concrete mix.

Core and Strength: Allows for completion of the hydration process, and result in a 28 day compressive strength of not less than 4,500 psi.

Manufacture: Fiberglass molds used to insure uniform parts. Mold parting lines may be slightly visible in finished parts.

Anchorage: Four steel mounting tabs for installation on four 1/2" x 10" + 2" zinc electroplated L-hook anchor bolts. Each anchor bolt is supplied with two nuts, two washers, and a rigid pressed board template.

Shipment: Palletized with adequate hold-downs to prevent load movement in transit.

Finish: Each luminaire receives a fade and abrasion resistant, electrostatically applied, thermally cured, triglycidal isocyanurate (TGIC) polyester powdercoat finish. Standard colors include (BL) Black, (DB) Dark Bronze, (WH) White, (PS) Platinum Silver, (SG) Stealth Gray, (LG) Light Gray, and (CC) Custom Color (Include RAL#).

Listed to: UL 1598 Standard for Luminaires - UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products and CSA C22.2#250.0 Luminaires. RoHS compliant. Meets Buy American provisions within ARRA.

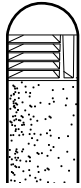
Warranty: Kim Lighting warrants Bollard LED products sold by Kim Lighting to be free from defects in material and workmanship for (i) a period of five (5) years for metal parts, (ii) a period of five (5) years for exterior housing paint finish(s), (iii) a period of five (5) years for LED Light Engines and, (iv) a period of five (5) years for LED power components (driver, surge protector and LifeShield® device), from the date of sale of such goods to the buyer as specified in Kim Lighting shipment documents for each product.

CAUTION: Fixtures must be grounded in accordance with national, state and/ or local electrical codes. Failure to do so may result in serious personal injury.


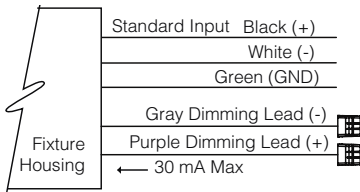
KIM LIGHTING RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE

Type:

Job:

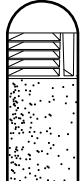


Standard Features

<p>Fixture</p>	<p>Cat. No. VRB2C Dual Function, Concrete Shaft, Domed Top</p>			
<p>Electrical Module LED = Light Emitting Diode</p>	<p>Cat. Nos. for LED Electrical Modules available:</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center; vertical-align: top;"> <p>xL</p> <p>Source:</p> <p><input type="checkbox"/> 10L = 10 LED (IES Type I)</p> <p><input type="checkbox"/> 15L = 15 LED (IES Type III)</p> <p><input type="checkbox"/> 20L = 20 LED (IES Type V)</p> </td> <td style="text-align: center; vertical-align: top;"> <p>xK</p> <p>Color Temperature:</p> <p><input type="checkbox"/> 2K = 580nm - Amber</p> <p><input type="checkbox"/> 3K = 3000K</p> <p><input type="checkbox"/> 4K = 4200K</p> <p><input type="checkbox"/> 5K = 5100K</p> </td> <td style="text-align: center; vertical-align: top;"> <p>UV</p> <p>Voltage:</p> <p><input type="checkbox"/> UV Universal Voltage shall range from 120V-277V</p> </td> </tr> </table>	<p>xL</p> <p>Source:</p> <p><input type="checkbox"/> 10L = 10 LED (IES Type I)</p> <p><input type="checkbox"/> 15L = 15 LED (IES Type III)</p> <p><input type="checkbox"/> 20L = 20 LED (IES Type V)</p>	<p>xK</p> <p>Color Temperature:</p> <p><input type="checkbox"/> 2K = 580nm - Amber</p> <p><input type="checkbox"/> 3K = 3000K</p> <p><input type="checkbox"/> 4K = 4200K</p> <p><input type="checkbox"/> 5K = 5100K</p>	<p>UV</p> <p>Voltage:</p> <p><input type="checkbox"/> UV Universal Voltage shall range from 120V-277V</p>
<p>xL</p> <p>Source:</p> <p><input type="checkbox"/> 10L = 10 LED (IES Type I)</p> <p><input type="checkbox"/> 15L = 15 LED (IES Type III)</p> <p><input type="checkbox"/> 20L = 20 LED (IES Type V)</p>	<p>xK</p> <p>Color Temperature:</p> <p><input type="checkbox"/> 2K = 580nm - Amber</p> <p><input type="checkbox"/> 3K = 3000K</p> <p><input type="checkbox"/> 4K = 4200K</p> <p><input type="checkbox"/> 5K = 5100K</p>	<p>UV</p> <p>Voltage:</p> <p><input type="checkbox"/> UV Universal Voltage shall range from 120V-277V</p>		
<p>Finish TGIC thermoset polyester powder coat paint applied over a titanated zirconium conversion coating on fixture top cap. Concrete shaft surface color is integral in concrete mix. Available in any combination of paint and concrete finishes listed at right.</p>	<p>Top Cap Color: Black Dark Bronze Light Gray Stealth Gray Platinum Silver White Custom Color¹ Cat. No.: <input type="checkbox"/> BL <input type="checkbox"/> DB <input type="checkbox"/> LG <input type="checkbox"/> SG <input type="checkbox"/> PS <input type="checkbox"/> WH <input type="checkbox"/> CC</p> <p>Concrete Shaft Color: Brown Charcoal Natural Gray White Cat. No.: <input type="checkbox"/> BR-C <input type="checkbox"/> CH-C <input type="checkbox"/> NG-C <input type="checkbox"/> WH-C</p> <p>NOTE: Black and Dark Bronze colors will produce slightly less louver brightness than Light Gray or White. ¹ Custom colors subject to additional charges, minimum quantities and extended lead times. Available on fixture head only. Consult representative. Custom color description: _____</p>			
<p>Battery Back-up Cat. No. <input type="checkbox"/> EM <input type="checkbox"/> No Option</p>	<p>Internal battery pack provides 90 minutes of supplemental light at 50% of initial lamp lumens.</p> <div style="text-align: right;">  <p>battery back-up</p> </div>			
<p>0-10V Dimming Interface</p>	<p>Driver has a 0-10V dimming interface with a dimming range of 10-100%. Is compatible with most control systems including Hubbell Building Automation wiHUBB™. Approved dimmers include Lutron Diva AVTV, Lutron Nova NFTV and NTFTV. Note: Not compatible with current sourcing dimmers. Controls compatible via Gray and Purple dimming lead.</p> <div style="text-align: right;">  </div>			

Type:

Job:



Lumen Data

Spectroradiometric			
	3000K Average	4200K Average	5100K Average
Correlated Color Temp. CCT (K)	2800K - 3175K	3800K - 4600K	4600K - 5600K
Color Rendering Index (CRI)	≥75	≥70	≥65
Power Factor	>.90	>.90	>.90

Projected Lumen Maintenance		
mA	50,000 hrs	100,000 hrs
350mA	N/A	N/A

Based on 20LED version.

Electrical Drive Current - @350mA						
Volts - AC	Type 1		Type 3		Type 5	
	Amps - AC	System Watts	Amps - AC	System Watts	Amps - AC	System Watts
120	0.11	13	0.16	19	0.21	25
208	0.06	13	0.09	19	0.12	25
240	0.05	13	0.08	19	0.10	25
277	0.05	13	0.07	19	0.09	25

B.U.G. Rating (TM15) in Lumens where B = Backlight, U = Uplight, G = Glare			
Temperature	TYPE 1	TYPE 3	TYPE 5
3000K	N/A	N/A	B1 U2 G1
4200K	N/A	N/A	B1 U2 G1
5100K	N/A	N/A	B1 U3 G1

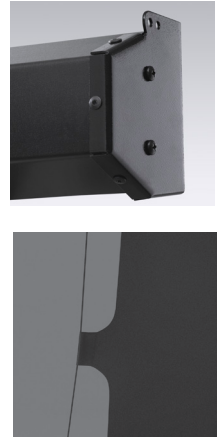
Absolute Lumens			
Temperature	TYPE 1	TYPE 3	TYPE 5
3000K	N/A	N/A	816
4200K	N/A	N/A	1012
5100K	N/A	N/A	1063

LED performance and lumen output continues to improve at a rapid pace. Log onto www.kimlighting.com to download the most current photometric files from Kim Lighting's IES File Library. For custom optics and color temperature configurations, contact factory.

Size: Viewable Screen Diagonal 161". Viewable Screen Height and Width 79" x 140.4".

ELECTRIC Premier

TAB-TENSIONED, CEILING- OR WALL-MOUNTED



Chapel/Performing Arts Center at Walnut Village Retirement Community, Anaheim, CA
133" HDTV Premier with Cineflex viewing surface and a Scissor Lift SL8
Dealer: CCS Presentation Systems, Inc., Photography © Douglas Hill, Los Angeles, CA

■ Ideal for conference rooms, classrooms, or home theaters, the economical Premier wall- or ceiling-mounted, electric projection screen offers a tab-tensioned viewing surface. Housed in an attractive black pentagonal steel case, the motor-in-roller is insulated to provide the Premier with a smooth, quiet operation.

THIS SCREEN IS TAB-TENSIONED
RF welded tabs eliminate stickiness and tab separation. Tabs warranted against separation for five years. Tab-tensioned screens provide a perfectly flat viewing surface with better image quality.

FEATURES

- Image area fully framed with black. Standard 12" black drop at top of viewing area.
- Steel case with baked-on black plastisol finish (standard), white available upon request. Includes matching endcaps with universal mounting brackets.
- Optional white aluminum ceiling trim kit available for recessed installation. Additional 12" black top drop recommended for ceiling-recessed installation.
- Optional wall- or ceiling-mounting brackets for added flexibility.
- Includes one 110-120V, 3-position switch (standard).
- WARRANTY: One year against defects in materials and workmanship.



OPTIONS

- **Control options:** Optional Plug & Play with built-in low-voltage controller (LP) or with built-in quiet, low-voltage controller (QLP). Screens over 119" (302 cm) diameter on 16:9 format on this screen cannot use QLP.
- **Viewing Surfaces:** TecVision®, OptiFlex™ (tensioned), CineFlex™ (rear projection), and ClearSound™ Perf families.

SUPPORTING DOCUMENTS

All instructions, technical drawings and other supporting documents are located at: draperinc.com/Documents.aspx

SIZES

- **Case dimensions** 5-7/8" high x 5-1/4" deep (15 cm x 13 cm). Optional built-in controls and extra drop may increase case length.
- **Maximum image width** 12' (366 cm), depending on surface selection.
- 16:10 FORMAT: 67" (170 cm) to 165" (419 cm) diagonal.
- **16:9 HDTV FORMAT:** 65" (165 cm) to 161" (409 cm) diagonal.
- 4:3 NTSC/PAL FORMAT: 72" (183 cm) to 15' (547 cm) diagonal.
- AV FORMAT: from 50" x 50" (127 cm x 127 cm) to 12' x 12' (366 cm x 366 cm)
- Custom sizes available.

For more information on this product visit: draperinc.com/projectionscreens/electricscreens.aspx

SECTION 26 0500

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Common electrical installation requirements.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Panels."

- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application

2.3 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs, under wall footings and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
 - 1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - 2. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.
 - 4. Seal space outside of sleeves with grout for penetrations of concrete and masonry with approved joint compound for gypsum board assemblies.
- G. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- J. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- K. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Lugs and Pads
 - 2. Wires and Cables
 - 3. Connectors

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lugs and Pads:
 - 1. Anderson
 - 2. IlSCO
 - 3. Panduit
 - 4. Thomas & Betts
 - 5. 3M
 - 6. Or approved equivalent.
- B. Wires and Cables:
 - 1. General
 - a. General Cable
 - b. Okonite
 - c. Southwire
 - d. Or approved equivalent.
 - 2. Metal Clad Cable - Type MC:
 - a. Afflex
 - b. AFC
 - c. General Cable
 - d. Southwire
 - e. Or approved equivalent.
- C. Connectors:
 - 1. Anderson Power Products
 - 2. Burndy
 - 3. IlSCO
 - 4. 3M
 - 5. Thomas & Betts
 - 6. Or approved equivalent.

2.2 LUGS AND PADS

- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.
- B. Copper Pads: Drilled and tapped for multiple conductor terminals.

- C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.

2.3 WIRES AND CABLES

- A. Copper, 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid or stranded. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THWN-2, XHHW-2 or THHN-2.
- B. Fire Pumps: Provide copper conductors. Aluminum is not acceptable.
- C. Annealed copper, Class "B" strand, designed to ensure tensile strength under fire conditions. 2- hour fire-resistive cable. 600 volt rated throughout. Conductors 8 AWG through 750 KCMIL. Insulation type: Thermoset, low smoke zero halogen (LS2H) silicone rubber. Jacket: Cross- linked polyolefin (XLPO), low smoke, zero halogen. UL 44 listed and certified to UL 2196.
- D. Aluminum, 600 volt rated throughout. Conductors 4 AWG and larger, compact stranded. Aluminum Association 8000(AA-8000) Series alloy conductor material built to ASTM B801 specifications. Connectors and terminations to be those listed by Underwriters Laboratories Standard 486-B and marked "AL7CU" for 60C and 75C rated circuits. Connections and terminations to be installed strictly in accordance with manufacturers recommendations.
- E. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- F. Color Code Conductors as Follows:

PHASE	208 VOLT WYE	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B	Red	Orange (High Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray or White w/colored strip
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	N/A	N/A

- G. MC Cable: Not allowed.
- H. MC Cable: High strength galvanized steel flexible armor. Full length minimum size No. 12 copper ground wire, THHN 90C conductors, full length tape marker phase/circuit identification on cable armor. Short circuit throat insulators, mechanical compression termination.
- I. AC Cable (Armored Cable): Not allowed.
- J. AC Cable (Armored Cable): Continuous corrugated aluminum armor, black. PVC jacket, with grounding conductor, XHHW-2 90 degrees C conductors, full length tape marker on jacket.

- K. NMB Cable: Not allowed.
- L. NMB Cable: Annealed copper conductors, 600 volt rated. Minimum Size No. 12 or 14 with ground wire. 90C rated, PVC or nylon jacketed insulation.
- M. SO Cord: Annealed copper conductors, 600 volt rated. Minimum size No. 12 AWG with ground wire. Maximum of six conductors and ground per cable. 90 degrees C rated thermosetjacket.
- N. Service Entrance Cable: Copper conductor, 600 volt insulation, XHHW, Type SE.

2.4 CONNECTORS

- A. Split bolt connectors not allowed.
- B. Aluminum Cable Compression Connections:
 - 1. Provide UL-listed compression lugs that are marked AL7CU or AL9CU and have passed UL 486B or UL 486C testing procedures.
 - 2. Construction: Electro tin plated high conductivity aluminum. Connector marked with wire size, die index, color-coded and the proper number and location of crimps. Factory pre- filled with oxide inhibiting compound.
 - 3. Aluminum cable connection to aluminum bus bar: Use 2-hole aluminum compression lug and aluminum hardware. Apply UL-listed lubricant to hardware and surfaces before tightening.
 - 4. Aluminum cable connection to copper bus bar: Use 2-hole aluminum compression lug, plated steel hardware and Belleville washer. Apply UL-listed lubricant to hardware and surfaces before tightening.
 - 5. Aluminum cable connection to mechanical lugs and equipment identified as not suitable for aluminum conductor termination: Provide aluminum compression lug with stranded copper wire/cable pigtail. Equip lug compression body with insulating cover.
 - 6. Aluminum cable connection to dry-type transformer lugs.
 - 7. Aluminum Termination Hardware:
 - a. Bolts: Anodized alloy 2023-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
 - b. Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
 - c. Washers: Flat aluminum alloy Alclad 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2. SAE or narrow series washers are not permitted.
- C. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.
- D. Fluorescent Luminaire Disconnect: polycarbonate housing, tin-plated brass contacts, insulated 18 AWG, factory-installed solid copper leads, 105C temperature rating, UL94-V2 flammability, 4A, 600V. NEC Article 410 compliant. Finger-safe line side. Push-and-click connector.

END OF SECTION

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SECTION 26 0533

RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Rigid Metal Conduit (RMC)
 - 2. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Metal Conduit
 - 3. Electrical Metallic Tubing (EMT)
 - 4. Flexible Metal Conduit (FMC)
 - 5. Liquidtight Flexible Metal Conduit (LFMC)
 - 6. Electrical Polyvinyl Chloride (PVC) Conduit
 - 7. Conduit Fittings

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Rigid Metal Conduit (RMC):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing Inc.
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
- B. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit:
 - 1. Allied Tube & Conduit
 - 2. Thomas & Betts Corporation
 - 3. Robroy Industries
 - 4. O'kote Inc.
 - 5. Or approved equivalent.
- C. Electrical Metallic Tubing (EMT):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing WL
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
- D. Flexible Metal Conduit (FMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.
- E. Liquidtight Flexible Metal Conduit (LFMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.

- F. Electrical Polyvinyl Chloride (PVC) Conduit:
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. JM Eagle
 - 5. Or approved equivalent.

 - G. Conduit Fittings:
 - 1. Bushings:
 - a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
 - 1) Thomas & Betts 1222 Series
 - 2) O-Z Gedney B Series
 - 3) Or approved Equivalent.
 - 2. Raceway Connectors and Couplings:
 - a. Thomas & Betts Series
 - b. O-Z Gedney Series
 - c. Or approved Equivalent.
 - 3. Expansion/Deflection Fittings:
 - a. EMT: O-Z Gedney Type TX
 - b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
 - c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy OPEJ Series
 - d. Or approved equivalent.
- 2.2 RIGID METAL CONDUIT (RMC)
- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
 - 1. Fittings: NEMA FB2.10.
- 2.3 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT
- A. Description: UL 6, ANSI C80.1, and NEMA RN 1; rigid steel conduit with external PVC coating.
 - 1. PVC Coating: Minimum 40 mils in thickness.
 - B. Fittings and Conduit Bodies: NEMA FB-1; steel fittings with external PVC coating to match conduit.
- 2.4 ELECTRICAL METTALIC TUBING (EMT)
- A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
 - B. Fittings: NEMA FB 1; steel, compression type.
- 2.5 FLEXIBLE METAL CONDUIT (FMC)
- A. Description: UL 1, Interlocked steel construction.
 - B. Fittings: NEMA FB 2.20.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.
- B. Fittings: NEMA FB 2.20.

2.7 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: UL 651, NEMA TC 2; Schedule 40 PVC.
- B. Fittings: NEMA TC 3.

2.8 CONDUIT FITTINGS

- A. Bushings:
 - 1. Insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection.
 - 2. Insulated grounding type for threaded raceway connectors.
- B. Raceway Connectors and Couplings:
 - 1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
 - 2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
 - 3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
 - 4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
 - 5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.
- C. Provide expansion/deflection fittings for EMT.

END OF SECTION

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SECTION 26 0534

BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Outlet Boxes
 - 2. Floor Boxes and Poke-Thrus
 - 3. Pull and Junction Boxes
 - 4. Box Extension Adapter
 - 5. Weatherproof Outlet Boxes
- B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Outlet Boxes:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Randl.
 - 5. Or approved equivalent.
- B. Floor Boxes and Poke-Thrus:
 - 1. Legrand (Wiremold)
 - 2. FSR
 - 3. Hubbell
 - 4. Thomas & Betts
 - 5. MonoSystems
 - 6. Eaton/Crouse-Hinds
 - 7. Or approved equivalent.
- C. Pull and Junction Boxes:
 - 1. Eaton/Crouse-Hinds
 - 2. Hoffman
 - 3. Or approved equivalent.
- D. Box Extension Adapter:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Or approved equivalent.
- E. Weatherproof Outlet Boxes:

1. Legrand (Pass & Seymour)
2. Hubbell
3. Thomas & Betts
4. Eaton/Crouse-Hinds
5. Intermatic
6. Or approved equivalent.

2.2 OUTLET BOXES

- A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep. Single- or two-gang flush device raised covers.
- C. Telecom Outlet: Provide 5-inches square, minimum 2-1/8-inch deep box with single gang plaster ring by Randl.
- D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- E. Masonry Boxes: Outlets in concrete.
- F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
- G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- H. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 FLOOR BOXES AND POKE-THRUS

- A. Basis of Design: Floor boxes and poke-thrus are based on Legrand/Wiremold as the manufacturer. Manufacturers are approved for use on this project on condition of meeting or exceeding basis of design for conditions of use, box capacity, total allowed connecting conduit capacity, and available finishes. Products ordered or installed not meeting basis of design are subject to removal and replacement at no cost to Owner.
- B. Floor Boxes:
 1. Multi-Gang Box, Slab on Grade: Cast iron housing rated for slab on grade application, fully adjustable, accepts up to 2-inch conduits. Rubber gasket protects interior from water and debris. 2-gang. Provide with up to two (2) duplex receptacle(s), up to eight (8) telecom outlets and up to three (3) gangs for AV connections. Rectangular activation, flanged, for use with matching carpet or tile insert. Finish: aluminum. Wiremold Evolution EFB6-OG, EFB8-OG or EFB10-OG, sized for required connections or approved equal.
 2. Multi-Gang Box, Slab above Grade: Steel housing rated for fire rated slab above grade application, fully adjustable, accepts up to 2-inch conduits, fire rated for 2-hours. Rubber gasket protects interior from

water and debris. 2-gang. Provide with up to two (2) duplex receptacles, up to eight (8) telecom outlets and up to three (3) gangs for AV connections. Rectangular activation, flanged, for use with matching carpet or tile insert. Finish: aluminum. Wiremold EFB6-FC, EFB8-FC or EFB10-FC, sized for required connections or approved.

3. Face-Up Floor Box, Slab on Grade: Cast-iron housing rated for slab on grade application, fully adjustable, accepts up to 1.25-inch for power and 2-inch for telecom. Rubber gasket protects interior from water and debris. 1-gang. Rectangular activation, flanged with Decora style flip cover. Finish: aluminum. Legrand/Wiremold 880CM series or approved.
4. Face-Up Floor Box, Slab above Grade: Steel housing rated for fire rated slab above grade application, fully adjustable, accepts up to 1.25-inch for power and 2-inch for telecom, fire rated for 2-hours. Rubber gasket protects interior from water and debris. 1- gang. Rectangular activation, flanged with Decora style flip cover. Finish: aluminum. Legrand/Wiremold 8801S-FC series or approved.

2.4 PULL AND JUNCTION BOXES

- A. Construction: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- B. Location:
 1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.
- C. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 1. Construction: Galvanized cast iron.
 2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 3. Cover Legend: ELECTRIC.
- D. Fiberglass Handholes: Die molded glass fiber hand holes:
 1. Cable Entrance: Pre-cut 6- x 6-inch cable entrance at center bottom of each side.
 2. Cover: Fiberglass weatherproof cover with nonskid finish.
 3. Cover Legend: ELECTRIC.

2.5 BOX EXTENSION ADAPTER

- A. Construction: Diecast aluminum.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.6 WEATHERPROOF OUTLET BOXES

- A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap suitably configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

END OF SECTION

SECTION 26 0541

UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of underground ducts and raceways, and precast manholes and pullboxes to form a complete underground electrical raceway system.
- B. The terms “duct” and “conduit” are used interchangeably in this section.

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. EARTH MOVING: Trenching, backfill, and compaction.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, manholes, and pullboxes with final arrangement of other utilities, site grading, and surface features.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit information on manholes, pullboxes, ducts, and hardware. Submit manhole plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.
 - c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pullboxes, or duct banks at locations other than shown

- on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the Facility Manager for approval prior to construction.
- 2. Certifications: Two weeks prior to the final inspection, submit the following.
 - a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Concrete Institute (ACI):
 - Building Code Requirements for Structural Concrete
 - 318-14/318M-14 Building Code Requirements for Structural Concrete & Commentary
 - SP-66-04 ACI Detailing Manual
- C. American National Standards Institute (ANSI):
 - 77-14 Underground Enclosure Integrity
- D. American Society for Testing and Materials (ASTM):
 - C478 REV A-15 Standard Specification for Precast Reinforced Concrete Manhole Sections
 - C858-10 Underground Precast Concrete Utility Structures
 - C990-09 Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
- E. National Electrical Manufacturers Association (NEMA):
 - TC 2-13 Electrical Polyvinyl Chloride (PVC) Conduit
 - TC 3-15 Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit And Tubing
 - TC 6 & 8-13 Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installations
 - TC 9-04 Fittings For Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installation
- F. National Fire Protection Association (NFPA):
 - 70-17 National Electrical Code (NEC)
 - 70E-15 National Electrical Safety Code
- G. Underwriters Laboratories, Inc. (UL):
 - 6-07 Electrical Rigid Metal Conduit-Steel
 - 467-13 Grounding and Bonding Equipment
 - 651-11 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
 - 651A-11 Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

PART 2 - PRODUCTS

2.1 PRE-CAST CONCRETE MANHOLES AND HARDWARE

- A. Structure: Factory-fabricated, reinforced-concrete, monolithically-poured walls and bottom. Frame and cover shall form top of manhole.
- B. Cable Supports:
 - 1. Cable stanchions shall be hot-rolled, heavy duty, hot-dipped galvanized "T" section steel, 56 mm (2.25 inches) x 6 mm (0.25 inch) in size, and punched with 14 holes on 38 mm (1.5 inches) centers for attaching cable arms.
 - 2. Cable arms shall be 5 mm (0.1875 inch) gauge, hot-rolled, hot-dipped galvanized sheet steel, pressed to channel shape. Arms shall be approximately 63 mm (2.5 inches) wide x 350 mm (14 inches) long.
 - 3. Insulators for cable supports shall be porcelain, and shall be saddle type or type that completely encircles the cable.
 - 4. Equip each cable stanchion with one spare cable arm, with three spare insulators for future use.
- C. Ladder: Aluminum with 400 mm (16 inches) rung spacing. Provide securely-mounted ladder for every manhole over 1.2 M (4 feet) deep.
- D. Ground Rod Sleeve: Provide a 75 mm (3 inches) PVC sleeve in manhole floors so that a driven ground rod may be installed.
- E. Sump: Provide 305 mm x 305 mm (12 inches x 12 inches) covered sump frame and grated cover.

2.2 PULLBOXES

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or COMMUNICATIONS as applicable. Pullboxes shall comply with the requirements of ANSI 77, loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening. Communications pullboxes will be H-20 rated.
- B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.

2.3 DUCTS

- A. Number and sizes shall be as shown on the drawings.
- B. Ducts (concrete-encased):
 - 1. Plastic Duct:
 - a. NEMA TC6 & 8 and TC9 plastic utilities duct, UL 651 and 651A Schedule 40 PVC conduit.
 - b. Duct shall be suitable for use with 90° C (194° F) rated conductors.
 - 2. Conduit Spacers: Prefabricated plastic.
- C. Ducts (direct-burial):
 - 1. Plastic duct:
 - a. UL 651, 651A, and 651B, Schedule 40 PVC or HDPE conduit Schedule 80 PVC.
 - b. Duct shall be suitable for use with 75° C (167° F) rated conductors.
 - 2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.

2.4 GROUNDING

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.5 WARNING TAPE

- A. 4-mil polyethylene 75 mm (3 inches) wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

2.6 PULL ROPE FOR SPARE DUCTS

- A. Plastic with 890 N (200 lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 MANHOLE AND PULLBOX INSTALLATION

- A. Assembly and installation shall be per the requirements of the manufacturer.
 - 1. Install manholes and pullboxes level and plumb.
 - 2. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inch) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
- B. Access: Ensure the top of frames and covers are flush with finished grade.
- C. Grounding in Manholes:
 - 1. Ground Rods in Manholes: Drive a ground rod into the earth, through the floor sleeve, after the manhole is set in place. Fill the sleeve with sealant to make a watertight seal. Rods shall protrude approximately 100 mm (4 inches) above the manhole floor.
 - 2. Install a No. 3/0 AWG bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips.
 - 3. Connect the ring grounding conductor to the ground rod by an exothermic welding process.
 - 4. Bond the ring grounding conductor to the duct bank equipment grounding conductors, the exposed non-current carrying metal parts of racks, sump covers, and like items in the manholes with a minimum No. 6 AWG bare copper jumper using an exothermic welding process.

3.2 TRENCHING

- A. Refer to civil for trenching, backfilling, and compaction.
- B. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. For Concrete-Encased Ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1.2 M (4 feet) intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
 3. The walls of the trench may be used to form the side walls of the duct bank, provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
 4. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.
- F. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the Facility Engineer.

3.3 DUCT INSTALLATION

A. General Requirements:

1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Join and terminate ducts with fittings recommended by the manufacturer.
3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 M (100 feet).
4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be ten times conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water. Telecommunications and electrical conduits shall maintain a separation of 12" of well pack soil or 3" of concrete.
10. Clearances between individual ducts:
 - a. For similar services, not less than 75 mm (3 inches).
 - b. For power and signal services, not less than 150 mm (6 inches).
11. Duct lines shall terminate at window openings in manhole walls as required. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.

15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
 16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
 17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.
 18. Telecommunications conduits are to be red slurry capped with a metallic marker tape 12" above the slurry.
 19. Maximum of 180 degree of bend between pull points for communications conduits. All bends in communications conduits will be sweeps with a minimum of 10 times the radius of the conduit.
 20. Top of low voltage communications conduit duct bank will be installed a minimum of 30" from finished grade. Communications conduits will be installed with conduit spacers to ensure positioning of conduits will not change during backfill or slurry.
- C. Connections to Manholes: Ducts connecting to manholes shall be flared to have an enlarged cross-section to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 300 mm (12 inches) in each direction. Perimeter of the duct bank opening in the manhole shall be flared toward the inside or keyed to provide a positive interlock between the duct and the wall of the manhole. Use vibrators when this portion of the encasement is poured to ensure a seal between the envelope and the wall of the structure.
- D. Connections to Existing Manholes: For duct connections to existing manholes, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.
- E. Connections to Existing Ducts: Where connections to existing ducts are indicated, excavate around the ducts as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.
- F. Partially-Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (12 inches) apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

- A. Duct Testing and Cleaning:
1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
 2. The mandrel shall be not less than 300 mm (12 inches) long, and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff

bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.

3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the Facility Engineer.
4. Mandrel pulls shall be witnessed by the Facility Engineer.

END OF SECTION

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SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment Nameplates
 - 2. Device Labels
 - 3. Wire Markers
 - 4. Conduit Markers
 - 5. Underground Warning Tape

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equipment Nameplates:
 - 1. B & I Nameplates
 - 2. Intellicum
 - 3. JBR Associates
 - 4. Or approved equivalent.
- B. Device Labels:
 - 1. Kroy
 - 2. Brady
 - 3. Or approved equivalent.
- C. Wire Markers:
 - 1. Brady
 - 2. Panduit
 - 3. Sumitomo
 - 4. Or approved equivalent.
- D. Conduit Markers:
 - 1. Allen Systems
 - 2. Brady
 - 3. Or approved equivalent.
- E. Underground Warning Tape:
 - 1. Allen Systems
 - 2. Brady
 - 3. Or approved equivalent.

2.2 EQUIPMENT NAMEPLATES

- A. Engraved phenolic plastic, laminate, minimum 1/8-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification L-P-387. All upper case letters in engraver standard letter style of the size and wording indicated. Punched for mechanical fastening, except where adhesive mounting is necessary due to substrate. Embossed tape style labels are not acceptable.
- B. Color:
 - 1. Normal (Utility): White letters on black background.
 - 2. Life Safety/Critical (Emergency Systems): Black letters on orange background.
 - 3. Equipment Branch (Legally Required Standby Systems): Black letters on yellow background.
- C. Letter Size:
 - 1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, etc.
 - 2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, etc.
 - 3. Use 3/16-inch minimum for identifying source, voltage, current, phase, and wire configurations.
- D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.
- F. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
- G. Locations:
 - 1. Switchgear, switchboards, sub-distribution switchboards, distribution panels, and branch panels.
 - 2. Main breakers and distribution breakers in switchgear, switchboards, and distribution panels.
 - 3. Equipment including, but not limited to, motor controllers, disconnects, and VFDs.
 - 4. Low-voltage equipment enclosures including, but not limited to, fire alarm panels, access control panels, and lighting control panels.
 - 5. Distribution transformers.

2.3 DEVICE LABELS

- A. Extra strength, laminated, adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches, receptacles, control device stations, etc. Indicate source panel and circuits. Wall switches with engraved buttons do not require labeling. Embossed tape style labels are not acceptable.
- B. Extra strength, laminated adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches and receptacles. Indicate device name, source panel, and source circuits. Panel and circuit designation written in permanent marker on the back of the plate and inside the back-box. Do not provide punch tape style labels.
- C. Label all junction boxes to show system identification, source circuit, or raceway origin. In

finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

- D. Device plates to have panel and circuit designation engraved in face, and highlighted in a contrasting color, and the circuit written in permanent marker on the back of the plate and inside the back-box.

2.4 WIRE MARKERS

- A. Description: Vinyl-cloth self-adhesive type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.
- C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.
- D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

2.5 CONDUIT MARKERS

- A. Description: Self-sticking vinyl.
- B. Location: Furnish markers for each conduit longer than 6-feet.
- C. Spacing: 20-feet on center.
- D. Color:
 - 1. 480 Volt System: Black letters on Orange background
 - 2. 208 Volt System: Black letters on Orange background
 - 3. Fire Alarm System: Red
 - 4. Telephone System: Orange

2.5 UNDERGROUND WARNING TAPE

- A. Description: 6-inch wide inert polyethylene plastic tape, 4-mil thick, detectable type, colored per APWA recommendations unless otherwise noted with suitable warning legend describing buried electrical lines.

END OF SECTION

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SECTION 26 0600

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included:
 - 1. Power system grounding.
 - 2. Electrical equipment and raceway grounding and bonding.
- B. Related work:
 - 1. Division 05: Metals.
 - 2. Division 22: Cold Water Plumbing.

1.2 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories, Inc. (UL):
 - a. UL 467; Grounding and Bonding Equipment.
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE No. 142; Recommended Practice for Grounding of industrial and Commercial Power Systems.

1.3 SYSTEM DESCRIPTION

- A. Grounding of the electrical service system neutral at the service entrance equipment is existing and part of the existing main switchboard. Electrical contractor shall arrange and pay for the services of an independent testing agency to perform all electrical testing required herein to ensure the continuity of the grounding system.
- B. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.
- C. Resistance:
 - 1. Resistance from the main switchboard ground bus through the ground electrode to earth shall not exceed 5 OHMS unless otherwise noted.
 - 2. Resistance from the farthest panelboard, switchboard, etc. ground bus through the ground electrode to earth shall not exceed 20 OHMS

1.4 SUBMITTALS

- A. Submit in accordance with the requirements of Section 26 01 00: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 3. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - 1. Ground Rods:
 - a. Weaver.
 - b. Erico "Cadweld" Products, Inc.
 - 2. Ground Wells:
 - a. Christy Concrete Products, Inc.
 - b. Forni Corp.
 - 3. Ground Bushings, Connectors, Jumpers and Bus:
 - a. O-Z/Gedney.
 - b. Thomas & Betts Corp.
- B. Substitutions: Under provisions of Section 26 01 00: Basic Electrical Requirements.

2.2 GROUND CONDUCTORS

- A. General purpose insulated: UL approved and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with NEC.
- B. Bare conductors in direct contact with earth or encased in concrete: #4 AWG copper minimum. U.O.N.
- C. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provide with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

2.3 DRIVEN (GROUND) RODS

- A. Copper clad steel, minimum 3/4-inch diameter by 10 feet long, unless otherwise noted.

2.4 GROUND WELL BOXES FOR GROUND RODS

- A. Precast concrete box nominal 9" throat diameter x 14" deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Cover shall be embossed or engraved with "GROUND ROD".

205 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.6 CONNECTIONS TO PIPE

- A. For cable to pipe: UL and NEC approved bolted connection.

2.7 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

- A. Where required by the drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
 - 1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
 - 2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series or equal.

2.8 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

- A. Where required by the drawing or specified herein.

2.9 MAIN BUILDING REFERENCE GROUND BUS

- A. Shall be furnished under a separate contract integral with the main service switchboard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall thoroughly examine site conditions for acceptance of grounding system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 INSTALLATION

- A. Grounding electrodes:
 - 1. Metal underground water pipe: Cold water metal piping system: Where the underground cold water service line is metal, in direct contact with the earth for 10 feet or more, the contractor shall install a grounding electrode conductor from the main incoming cold water line ahead of the meter and extend to the main building reference ground bus in the main electrical room. The electrode shall be sized per NEC Table 250-66. Electrode connection should be accessible.
 - 2. Concrete encased grounding electrode (UFER ground): Provide a #4 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings which are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. The electrode shall extend through a horizontal length of 20 feet minimum and shall be encased in not less than 2 or more than 5 inches of concrete separating it from surrounding soils. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to the main building reference ground bus.
 - 3. Supplementary grounding electrode (ground ring, grid, and driven rods): Provide, as shown on the drawings, driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod with structural steel and adjacent rods with minimum #4 AWG bare copper

conductor. Ground rod shall not be less than 10 foot from any other electrode of another electrical system or from adjacent ground rod(s).

- B. Grounding electrode conductor: Provide grounding electrode conductor as indicated on the drawings or sized per NEC Table 250-66, whichever is greater.
- C. Power system grounding:
 - 1. Provide a grounding electrode connection at each individual building on the campus. Connect the following items using NEC sized copper grounding conductors to lugs on each buildings service ground bus:
 - a. Grounding electrode conductor from metal underground water pipe, concrete encased electrode, and supplementary grounding electrodes. Ground electrode connections may already exist at each building, but where there are not existing they shall be provided.
 - b. Bonding conductor to metallic cold water piping system.
 - c. Bonding conductor to building structural steel.
- D. Equipment bonding/grounding:
 - 1. Provide a NEC sized insulated copper ground conductor in all 120VAC through 600 VAC feeder and branch circuit distribution conduits and cables.
 - 2. Provide a separate grounding bus at panelboards, switchboards. Connect all metallic enclosed equipment so that with maximum fault current flowing shall be maintained at not more than 35 volts above ground.
 - 3. Conduit terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
 - 4. Provide bonding jumpers across expansion and deflection couplings in conduit runs, pipe connections to water meters, dielectric couplings in metallic cold water piping system.
 - 5. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.
 - 6. Provide external ground wire wrapped around flexible conduit and terminate to connectors designed for the purpose.

3.3 FIELD QUALITY CONTROL

- A. Independent Testing: Electrical contractor shall arrange and pay for the services of an independent testing agency to perform all quality control electrical testing required herein.
- B. Prefunctional testing:
 - 1. Provide testing agency with contract documents for their review prior to the commencement of ground testing.
 - 2. Visual and mechanical inspection:
 - a. The testing agency shall inspect the grounding electrode and connections prior to concrete encasement, burial, or concealment.
 - b. Check tightness and welds of all ground conductor terminations.
 - c. Verify installation complies with the intent of the contract documents
 - 3. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required complying with resistance limits specified under this Section of the Specification.
 - 4. Typewritten records of measured resistance values shall be submitted for review and included with the operation and maintenance manual furnished to the District at the time of project closeout and before certificate of final payment is issued.

END OF SECTION

SECTION 26 0700

ELECTRICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included:
 - 1. Conduit supports.
 - 2. Equipment supports.
 - 3. Fastening hardware.

- B. Related work:
 - 1. Division 03 and 32: Cast-in-place concrete. Concrete equipment pads.
 - 2. Division 05: Miscellaneous metals. Hangers for electrical equipment.
 - 3. Division 09: Ceiling suspension systems. Slack fixture support wires.

1.2 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of electrical equipment furnished and installed under Division 26.

- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.3 SUBMITTALS

- A. Submit in accordance with the requirements of Section 26 01 00: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein.
 - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 3. Submit manufacturer's installation instructions.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - 1. Concrete fasteners:
 - a. Phillips "Red-Head".
 - b. Remington.
 - c. Ramset.
 - 2. Concrete construction channel:
 - a. Unistrut Corp.
 - b. GS Metals "Globe Strut."
 - c. Thomas & Betts "Kindorf" Corp.
 - 3. Conduit straps:
 - a. O-Z/Gedney.
 - b. Erico "Caddy" Fastening Products.
 - c. Thomas & Betts "Kindorf" Corp.

- B. Substitutions: Under provisions of Section 26 01 00: Basic Electrical Requirements.

2.2 CONCRETE FASTENERS

- A. Provide expansion-shield type concrete anchors.
- B. Provide powder driven concrete fasteners with washers. Obtain approval by Architect and Structural Engineer prior to use.

2.3 THREADED ROD

- A. Provide steel threaded rod, sized for the load unless otherwise noted on the Drawings or in the Specifications.

2.4 CONSTRUCTION CHANNEL

- A. Provide 1-1/2 inch by 1-1/2 inch, 12 gauge galvanized steel channel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.

2.5 CONDUIT STRAPS

- A. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
 - 1. Use malleable strap with spacers for exterior and wet locations.
 - 2. Use steel strap without spacers for interior locations.
- B. Steel channel conduit strap for support from construction channel.
- C. Steel conduit hanger for pendant support with threaded rod
- D. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 PREPARATION

- A. Coordinate size, shape and location of concrete pads with Division 32, Cast-in-place concrete.
- B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where shown on the Drawings or Specifications, install freestanding electrical equipment on concrete pads.

3.3 INSTALLATION

- A. Furnish and install supporting devices as noted throughout Division 26.

- B. Electrical device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
- E. Use expansion anchors or preset inserts in solid masonry walls.
- F. Use self-drilling anchors, expansion anchor on concrete surfaces.
- G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
- H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
- I. Do not drill structural steel members unless first approved in writing by the Architect or structural engineer.
- J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- K. Install surface-mounted cabinets and panelboards with minimum of 6 lag bolts. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
- L. Bridge studs top and bottom with blockings to support flush mounted cabinets and panelboards in stud walls.

3.4 ERECTION OF METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.5 WOOD SUPPORTS

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.6 ANCHORAGE

- A. All floor mounted, free standing electrical equipment shall be securely fastened to the floor structure.
- B. Anchorage of electrical equipment shall comply with the seismic requirements as outlined in Section 26 07 10: Electrical Supports and Seismic Restraints.

END OF SECTION

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SECTION 26 0710

ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Seismic restraints for electrical equipment and systems.
 - 3. Construction requirements for concrete bases.

1.3 DEFINITIONS, CBC, California Building Code, Latest Edition

- A. EMT: Electrical metallic tubing.
- B. IBC: International Building Code.
- C. IMC: Intermediate metal conduit.
- D. NBC: National Building Code.
- E. OSHPD: Office of Statewide Health Planning and Development.
- F. RMC: Rigid metal conduit.
- G. SBC: Standard Building Code.
- H. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.
- I. CBC – California Building Code 2013.

1.4 SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.
 - 1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by the ICBO Evaluation Service.
 - 2. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Professional engineer qualification requirements are specified in Division 01 Section "Quality Control." Include the following:

1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By the ICBO Evaluation Service, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For Licensed Professional Engineer in the State of California and testing agency approved by the Governing Authority.
- F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the California Building Code unless requirements in this Section are more stringent.
- B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3 and in Division 26 Section 26 07 10 "Electrical Supports and Seismic Restraints."
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.06 PROJECT CONDITIONS

- A. Project Seismic Zone as Defined in the CBC: Zone 4.
- B. Project Seismic Zone Factor as Defined in the CBC: Zone Factor 0.40 for floor mounted 0.175 for structure mounted.
- C. Occupancy Category as Defined in the CBC: I, II, III, IV.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
 1. Available Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Thomas & Betts Corporation.
 - d. Unistrut; Tyco International, Ltd.
 2. Finishes:
 - a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
 - b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-3.
 - c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.
 3. Channel Dimensions: Selected for structural loading and applicable seismic forces.
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers:
 1. Hilti, Inc.
 2. Simpson Strong-Tie Co. Inc.
 2. Mechanical-Expansion Anchors: zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers:
 1. Hilti, Inc.

3. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS

- A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by the ICBO Evaluation Service
 1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.
- B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.
- C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.
 1. Available Manufacturers:
 - a. Amber/Booth Company, Inc.
 - b. Loos & Co., Inc.
 - c. Mason Industries, Inc.
 2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
 3. Hanger Rod Stiffener: Steel tube or steel slotted support system sleeve with internally bolted connections to hanger rod, of design recognized by ICBO Evaluation Service.
 4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
 5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to trapeze member with clamps approved for application by the ICBO Evaluation Service.
 - 2. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
- D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 6. Use 3000-psi (20.7-Mpa), 28-day compressive-strength concrete U.O.N on plans. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Restraint Cables: Provide slack within maximums recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at upper flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing: Test pullout resistance of seismic anchorage devices.
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test all of installed anchors and fasteners.
 - 5. Test to 150 percent of rated proof load of device.
 - 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Record test results.

END OF SECTION

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SECTION 26 0800

COMMISSIONING OF ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Definitions, warranties, test equipment requirements, and electrical commissioning requirements as required for LEED Certification and by the Owner's Project Requirements.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this section.
- B. Reference Section 01 91 13, General Commissioning Requirements.

1.3 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Commissioning, inspecting, and testing not to modify terms or time periods of electrical equipment, systems, and controls warranties including related equipment and systems, and adjacent work.
 - 2. Electrical system warranties to start from date of Commissioning Agent acceptance.

1.4 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, reference:
 - 1. ASHRAE Guideline 0, The Commissioning Process.
 - 2. NECA 90, Commissioning Building Electrical Systems.
 - 3. Title 24 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings Section 120.8 Nonresidential Building Commissioning.
 - 4. LEED v4 Reference Manual.

1.5 SUBMITTALS

- A. Reference Section 01 91 13, General Commissioning Requirements, for specific submittal requirements.
- B. In addition, submit the following:
 - 1. Certificates of readiness.
 - 2. Certificates of completion of installation, prestart, and startup activities.
 - 3. Operations and Maintenance (O&M) manuals.
 - 4. Test reports.

1.6 COORDINATION

- A. Reference Section 01 91 13, General Commissioning Requirements, for requirements pertaining to coordination during the commissioning process.

1.7 DEFINITIONS

- A. Commissioning Authority: Commissioning Agent, representing the Owner and directing commissioning activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide testing equipment required to perform startup, initial checkout and functional performance testing for the equipment being tested under Division 26, Electrical. Furnish two-way radios for each testing participant.
- B. Furnish special equipment, tools and instruments (specific to tested equipment and only available from vendor) required for testing. At conclusion of commissioning, turn equipment over to the Owner except for stand-alone data logging equipment that may be used by the Commissioning Authority.
- C. Manufacturer: Furnish proprietary test equipment and software required by equipment manufacturer procedures for programming and/or start-up. Demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) to become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be furnished by the Commissioning Authority during commissioning.
- E. Testing equipment to be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the Commissioning Authority will prepare Pre- Functional Checklists for commissioned components, equipment, and systems.
- B. Red-lined Drawings:
 - 1. Verify equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
 - 2. Record the red-lined drawing changes, as a result of Functional Testing and incorporate into the final as-built drawings.
- C. Operation and Maintenance Data:
 - 1. Submit a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for commissioned

- equipment and systems.
- 2. The Commissioning Authority will review the O&M literature once for conformance to project requirements.
- 3. The Commissioning Authority will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Demonstration and Training:
 - 1. Provide demonstration and training as required by the specifications.
 - 2. Submit complete training plan and schedule to the Commissioning Authority four weeks prior to training.
 - 3. Submit training agenda for each training session to the Commissioning Authority one week prior the training session.
 - 4. Notify the Commissioning Authority at least 72 hours in advance of scheduled tests so that testing may be observed by the Commissioning Authority and Owner's Authorized Representative. Submit copies of the test record to the Commissioning Authority, Owner, and Architect.
 - 5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
 - 6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
 - 7. Review data in O&M Manuals.

3.2 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the Commissioning Authority.
- B. Attend construction phase controls coordination meetings.
- C. Participate in Electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the Commissioning Authority.
- D. Provide information requested by the Commissioning Authority for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- F. Prepare preliminary schedule for Electrical system orientation and inspections, operation and maintenance manual submissions, training sessions, equipment start-up and task completion for owner. Distribute preliminary schedule to commissioning team members.
- G. Update schedule as required throughout the construction period.
- H. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for commissioned equipment.
- I. Contractor to participate and complete checklists using the Commissioning Authority's web based commissioning software. A desktop, laptop, tablet, or iPad will be required.
- J. Assist the Commissioning Authority in verification and functional performance tests.

- K. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- L. Gather operation and maintenance literature on equipment, and assemble in binders as required by the specifications. Submit to Commissioning Authority 45 days after submittal acceptance.
- M. Coordinate with the Commissioning Authority to provide 48-hour advance notice so that the witnessing of equipment and system start-up and testing can begin.
- N. Participate in, and schedule vendors and contractors to participate in the training sessions.
- O. Provide written notification to the CM/GC and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system are operating as required.
 - 1. Electrical equipment including switchgear, panel boards, motor control centers, lighting, receptacles, dimmers and other equipment furnished under this Division.
 - 2. Automatic Lighting Controls.
 - 3. Photovoltaic Energy Systems.
- P. Obtain performance documentation from equipment supplier.
- Q. Provide training of the Owner's operating staff using expert qualified personnel.
- R. Equipment Suppliers
 - 1. Submit requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
 - 2. Assist in equipment testing per agreements with contractors.
 - 3. Provide information requested by Commissioning Authority regarding equipment sequence of operation and testing procedures.

3.3 TESTING PREPARATION

- A. Certify in writing to the Commissioning Authority that Electrical systems, subsystems, and equipment have been installed and started and are operating according to the Contract Documents.
- B. Certify in writing to the Commissioning Authority that Electrical instrumentation and control systems have been completed and that they are operating according to the Contract Documents.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.

- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the Commissioning Authority.

3.4 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the Commissioning Authority.
- B. Scope of Electrical testing includes the entire Electrical installation, from the incoming power equipment throughout the distribution system. Testing includes measuring, but is not limited to resistance, voltage, and amperage of system(s) and devices.
- C. Test operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The Commissioning Authority along with the Electrical contractor and other contracted subcontractors, including the fire alarm Subcontractor to prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Commissioning Authority and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The Commissioning Authority may direct that set points be altered when simulating conditions is not practical.
- H. The Commissioning Authority may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. Sampling is permissible on the testing of occupancy sensors as long the minimum sample size is 20 percent but no less than 4 units fully tested. Refer to Specification Section 01 91 13, General Commissioning Requirements for acceptance criteria.
- J. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- K. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.5 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26, Electrical Sections. Provide submittals, test data, inspector record and certifications to the Commissioning Authority.
- B. Electrical Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 26, Electrical Controls

Sections. Assist the Commissioning Authority with preparation of testing plans.

- C. Emergency Generator Testing and Acceptance Procedures: Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the Commissioning Authority.
 - D. Electrical Distribution System Testing: Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the Commissioning Authority.
 - E. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of components, systems and sub-systems. Evaluate the following equipment and systems:
 - 1. Automatic Lighting Controls (LCP, Occupancy Sensors, Daylighting Controls)
 - 2. Photovoltaic Renewable Energy Systems
- 3.6 PHOTOVOLTAIC ENERGY SYSTEM TESTING AND ACCEPTANCE PROCEDURES
- A. Provide technicians, tools, instrumentation and equipment to test performance of panels, inverters, combined panels and monitoring equipment of designated solar PV systems and components at the direction of the Commissioning Authority.
- 3.7 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT
- A. Reference Section 01 91 13, General Commissioning Requirements, for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.
- 3.8 OPERATION AND MAINTENANCE (O&M) MANUALS
- A. The Operation and Maintenance Manuals to conform to Contract Documents requirements as stated in Division 26, Electrical.
- 3.9 TRAINING OF OWNER PERSONNEL
- A. Electrical Contractor's training responsibilities:
 - 1. Provide the Commissioning Authority with a training plan two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - 3. Training starts with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which illustrates the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative provides the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of modes of operation of the specific piece of equipment

- are required. More than one party may be required to execute the training.
6. The training sessions follows the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 7. Training includes:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training includes start-up, operation in modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of plans and manuals in the facility.
 - g. Discuss any peculiarities of equipment installation or operation.
 8. Hands-on training includes start-up, operation in modes possible, including manual, shut- down and any emergency procedures and preventative maintenance of pieces of equipment.
 9. Fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 10. Schedule training after functional testing is complete, unless approved otherwise by the Owner.

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SECTION 26 0923

OCCUPANCY AND VACANCY SENSORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Occupancy/Vacancy Sensors (Ceiling Mounted)
 - 2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")
 - 3. Automatic Switches

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Occupancy/Vacancy Sensors (Ceiling Mounted):
 - 1. Passive Infrared Occupancy/Vacancy Sensors:
 - a. Sensor Switch
 - b. WattStopper
 - c. Leviton
 - d. Hubbell
 - e. Greengate
 - f. Or approved equivalent.
 - 2. Ultrasonic Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Sensor Switch
 - f. Or approved equivalent.
 - 3. Dual Technology Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Sensor Switch
 - f. Or approved equivalent.
- B. Combined Occupancy/Vacancy Sensor:
 - 1. Lutron
 - 2. Sensor Switch
 - 3. WattStopper
 - 4. Leviton
 - 5. Hubbell
 - 6. Greengate
 - 7. Or approved equivalent.

- C. Automatic Switches:
 - 1. Sensor Switch
 - 2. WattStopper
 - 3. Leviton
 - 4. Hubbell
 - 5. Greengate
 - 6. Or approved equivalent.

- D. Basis of Design: Occupancy/Vacancy sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 GENERAL

- A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).
- B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off). These sensors must meet California Title 24 requirements.
- C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.
- D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.
- E. Factory set sensors for maximum sensitivity.
- F. LED lamp built into sensor indicates when occupant is detected.
- G. Provide zero cross relay control with sensors and sensor/switched; relay contacts close and open with AC voltage signal is at zero.
- H. Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- I. Line Voltage Sensors, Control Units, and Relays: UL listed.

2.3 OCCUPANCY/VACANCY SENSORS (CEILING MOUNTED)

- A. Passive Infrared Sensors:
 - 1. Sensor Function: Detects human presence in floor area being controlled by detecting changes in Infrared energy. Sensor detects small movements, i.e., when people are writing while seated at a desk.
 - 2. Provide temperature compensated dual element pyro-electric sensor and with multi element Fresnel lens.
 - 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.

4. Provide daylight filter to ensure that sensor is insensitive to short-wavelength infrared waves, i.e., those emitted by sun.
 5. Adjustments and mounting hardware under removable cover to prevent tampering with adjustments and hardware.
 6. Sensor utilizes advanced digital signal processing technology to reduce false offs without reducing sensitivity.
 7. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic- off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1200 SF, unless otherwise noted on drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper CI-300 Series.
 8. Building Exterior Sensor:
 - a. Capable of mounting on walls, eaves or ceilings.
 - b. On/off control based on daylight levels via adjustable light level setting.
 - c. Line Voltage: provide sensor to match voltage of lighting controlled; capable of switching up to 1000 watts ballast and incandescent load.
 - d. Adjustable time delay from 15 seconds to 15 minutes.
 - e. Silicon gasketed to prevent water and dust intrusion. UL listed raintight.
 - f. Rated to operate in temperatures from -40 degrees F to 130 degrees F.
 - g. Provide each sensor with manufacturer supplied wire-guard.
 - h. Provide isolated relay for monitoring by security system
 - i. Coverage:
 - 1) Narrow beam up to 100 foot distance.
 - 2) 90 degree beam up to 50 foot distance.
 - j. Finish: White.
 - k. Basis of Design: Wattstopper EN Series.
 - l. Parking Lot Lighting Control:
 - 1) On/off control based on daylight levels via adjustable light level setting.
 - 2) Low Voltage Sensor: 24VDC power. Sensor operates luminaire high/low control.
 - 3) Adjustable time delay from 15 seconds to 15 minutes.
 - 4) Silicon gasketed to prevent water and dust intrusion. UL listed raintight.
 - 5) Rated to operate in temperatures from -40 degrees F to 130 degrees F.
 - 6) Sensor front rotates and pivots for coverage adjustment after installation.
 - 7) Basis of Design: Wattstopper EW Series
- B. Ultrasonic Occupancy/Vacancy Sensors:
1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
 2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 5. Provide adjustments and mounting hardware under removable cover to prevent tampering.

6. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic- off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
 - c. Coverage: 360 degree sensor range; coverage: 2,000 SF, unless otherwise noted on Drawings.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper WT Series.
 7. Ceiling Mounted Sensor - Hallway Sensor Coverage:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic- off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
 - c. Coverage: 90 linear feet.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper UT-300-3 Series.
- C. Dual Technology Sensors:
1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above.
 2. Function: Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.
 3. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic- off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1000 SF for half-step motion, unless otherwise noted on Drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper DT-300 Series.
- 2.4 COMBINED OCCUPANCY/VACANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")
- A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
 - B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.
 - C. Rated to switch loads: 800 watts incandescent or 120-volt ballast; 1000 watts 277 volt ballast. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.
 - D. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.
 - E. Provide integral off override switch with no leakage current to load or ground.
 - F. Vandal-resistant lens.

- G. Includes neutral wire to meet NEC 2014 Code.
- H. Finish: White.
- I. Alerts for impending shut-off: light flash, audible, both or none.
- J. Standard Sensor/Switch:
 - 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off). Factory set to manual on/auto off.
 - 2. 180 degree sensor range; coverage: 150 SF for desktop activity.
 - 3. Basis of Design: Wattstopper PW-101 Series.
- K. Dual Relay Sensor/Switch:
 - 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - 2. Dual auto-off buttons on face of switch allow end-user to turn off two switch legs in room space. Built-in light adjustable level sensor only turns off second of two relays when desired footcandle level is present. Otherwise similar to specifications above for single- zone sensor/switch.
 - 3. Defaults to Manual-ON to 50% operation for maximum energy savings.
 - 4. 180 degree sensor range; coverage: 150 SF for desktop activity.
 - 5. Finish: White.
 - 6. Basis of Design: Wattstopper PW-302.
- L. Sensor/Slide Dimmer:
 - 1. Line voltage slider dimmer allows for manual adjustment of lighting levels from 100 percent to 10 percent; compatible with two-wire line voltage 100 percent to 10 percent electronic dimming ballasts. Separate manual button for override 'off' control.
 - 2. 180 degree sensor range; coverage: 300 SF for desktop activity.
 - 3. Basis of Design: Wattstopper PW-100D/101D Series.
- M. Passive Infrared Wall Switch Vacancy-Only Sensors:
 - 1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - 2. Adjustable sensitivity (high, low presets).
 - 3. Basis of Design: Lutron Maestro MS Series.
- N. Dual Technology Wall Switch Vacancy-Only Sensors:
 - 1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - 2. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
 - 3. Basis of Design: Lutron Maestro MS Series.
- O. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
 - 1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - 2. Basis of Design: Lutron Maestro MSCL Series.
- P. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:
 - 1. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - 2. Basis of Design: Lutron Maestro 0-10V Dimmer Sensor MS Series.

2.5 AUTOMATIC SWITCHES

- A. Automatic ("Sentry") Switch:
1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 2. Controls up to 1800 watts at 120-volt, 4100-watts at 277-volt, suitable for ballast and motor loads.
 3. Compatible with Decora style faceplate.
 4. Zero crossing circuitry.
 5. Finish: Match wiring devices unless selected otherwise by Architect.
 6. Capable of being connected with other sentry switches to produce 3 and 4 way switching.
 7. Based on power interruptions of following durations from an upstream control panel, produces following effects:
 - a. 5 Seconds: Turns lighting off with no delay.
 - b. 3 Seconds: Turns lighting on with no delay.
 - c. 1 to 2 Seconds: Delayed off. Blinks lights and provides audible signal to room occupant. If switch push button is not pressed within 5 minutes, lights are turned off.
 8. Basis of Design: Wattstopper AS-100 Series.
- B. Digital Timer Switch:
1. Controls up to 1800 watts at 120 volt, 4100 watts at 277 volt, suitable for ballast and motor loads.
 2. Compatible with Decora style faceplate.
 3. Provide low voltage (24VAC/VDC) version where used as input to lighting relay panel; includes single-pole, double-throw isolated relay rated for 1A at 30VDC.
 4. Electroluminescent LCD display shows timer countdown.
 5. Time out setting range from 5 minutes to 12 hours. Lights can be turned off before time- out setting by holding down on/off button.
 6. Timer countdown can be reset to beginning by holding down push button for 2 seconds.
 7. Zero crossing circuitry.
 8. Finish: White.
 9. Room lighting flashed and switch beeps 5 minutes and 1 minute prior to switching room lighting off. Either visible or audible features can be disabled.
 10. Basis of Design: Wattstopper TS-400 Series.

END OF SECTION

SECTION 26 0924

DAYLIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Continuous Dimming Daylighting Controller
 - 2. Switched Daylighting Controller
 - 3. Local Continuous Dimming Photosensor
 - 4. Local Switched Photosensor

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Continuous Dimming Daylighting Controller:
 - 1. WattStopper
 - 2. Greengate
 - 3. Sensor Switch
 - 4. Or approved equivalent.
 - 5. Basis of Design: Daylighting sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.
- B. Switched Daylighting Controller:
 - 1. WattStopper
 - 2. Greengate
 - 3. Sensor Switch
 - 4. Or approved equivalent.
 - 5. Basis of Design: Daylighting sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.
- C. Local Continuous Dimming Photosensor:
 - 1. WattStopper
 - 2. Greengate
 - 3. Sensor Switch
 - 4. Or approved equivalent.

5. Basis of Design: Daylighting sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.
- D. Local Switched Photosensor:
1. WattStopper
 2. Greengate
 3. Sensor Switch
 4. Or approved equivalent.
 5. Basis of Design: Daylighting sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 CONTINUOUS DIMMING DAYLIGHT CONTROLLER

- A. Control dimming of interior lights in response to light level data, compatible with 0 to 10VDC dimming ballasts. Control system to be open loop, to provide three output control zones consisting of a 0 to 10VDC signals compatible with fluorescent dimmable ballasts. Control system to include three relay outputs capable of switching each of three output zones off after an adjustable time delay when a given channel is fully dimmed.
- B. Control module to include following characteristics:
1. Seven individually adjustable parameters for each channel:
 - a. Setpoint: 5 to 60 footcandles;
 - b. Minimum Output: 0 to 4 volts DC;
 - c. Maximum Output: 6 to 10 volts DC;
 - d. Ramp Rate: 5 to 60 seconds;
 - e. Fade Rate: 5 to 60 seconds;
 - f. Cutoff Time Delay: 0 to 20 minutes or disabled;
 - g. Load Shed Limit: 0 to 10 volts DC.
 2. Compatible with 0 to 10VDC dimming ballasts.
 3. Suitable for panel mounting on DIN rail.
 4. When daylighting is adequate for a channel to fully dim; lights switch off after an adjustable time delay via relay pack connected to controller. This feature can also be disabled if lights must remain when fully dimmed.
 5. LCD display with menu-driven, pushbutton programming without special tools or accessories; automatic internal calculation for dimming requirements of individual channels for simplified setup.
 6. Operates from either 120VAC or 277VAC power source.
 7. Automatic Off Control.
- C. Utilize low voltage photosensor to continuously measure light levels. Photosensor range is 30 to 6000 footcandles. Adjustments and calibrations capable of being made at control module, not at remote photosensor.
- D. Basis of Design: WattStopper LCD-203 series control module with LS-290C photosensor and WattStopper BT-203 power pack. Control module mounted in factory-approved enclosure with

factory-installed DIN rails (WattStopper LS-E8, LS-E12, or approved equivalent) and DC power supplies as needed.

2.3 SWITCHED DAYLIGHTING CONTROLLER

- A. Switched control of interior lights in response to photocell input. Control system to be open loop, and will provide three output control zones as shown on Drawings.
- B. Control module will include following characteristics:
 - A. Five individually adjustable parameters for each channel:
 - a. Setpoint: 5 to 60 footcandles;
 - b. Programmable Deadband: 10 to 80 percent;
 - c. On Delay: 5 to 60 seconds;
 - d. Off Delay: 3 to 60 minutes;
 - e. Load Shed Limit: 5 to 60 footcandles.
 - B. Compatible with 0 to 10VDC dimming ballasts.
 - C. Suitable for panel mounting on DIN rail.
 - D. Lights switched via relay pack connected to controller.
 - E. LCD display with menu-driven, pushbutton programming without special tools or accessories; automatic internal calculation for dimming requirements of individual channels for simplified setup.
 - F. Operates from either 120VAC or 277VAC power source.
- C. Utilize low voltage photosensor to continuously measure light levels. Photosensor range is 30 to 6000 footcandles. Adjustments and calibrations will be capable of being made at control module, not at remote photosensor.
- D. Basis of Design: WattStopper LCO-203 series control module with LS-290C photosensor and WattStopper BT-203 power pack. Mount control module in factory-approved enclosure with factory-installed DIN rails (WattStopper LS-E8, LS-E12, or approved equivalent) and DC power supplies as needed.

2.4 LOCAL CONTINUOUS DIMMING PHOTOSENSOR

- A. Provide low voltage, indoor photocell to interface with electronic dimming ballasts using low voltage (0 to 10VDC) control signal.
- B. Spectral filtering system to measure relative levels of daylighting and indoor lighting within control space. Measures light as human eye perceives; linear photocell response with greater than 1 percent accuracy.
- C. Ceiling-mounted 2.4-inch diameter, 0.875-inch depth white housing.
- D. 10VDC input voltage, 0.2 to 10VDC output voltage. 20 to 60 footcandle adjustable range with plus or minus 3 percent accuracy. One photocell controls up to 50 ballasts. 5 year warranty. White finish.
- E. Automatic Off Control.
- F. Provide with separate handheld remote controller to field program target lighting levels for daytime and nighttime (i.e. when plenty of daylighting is available and when no daylighting is available).
- G. Basis of Design: WattStopper LS-301 Series.

2.5 LOCAL SWITCHED PHOTOSENSOR

- A. Low voltage, indoor photosensor to switch lighting using power pack; integrate with room occupancy sensors.
 - A. LCD display under removable cover to display four user-adjustable parameters:
 - a. ON Setpoint.
 - b. 1-850 footcandles.
 - c. OFF Setpoint (25 percent to 100 percent above ON Setpoint).
 - d. OFF Setpoint time delay (3 to 30 minutes).
 - B. Dimensions: 2.4-inches diameter by 0.7-inches deep.
 - C. White finish; surface mounted. Mountable in top-lit or side-lit position.
 - D. Voltage: 12/24VDC. LED status indicator.
- B. Basis of Design: WattStopper LS-101 Series.

END OF SECTION

SECTION 26 09 25

DIGITAL LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included:
 - 1. General Performance
 - 2. Digital Wall or Ceiling Mounted Occupancy Sensor System
 - 3. Digital Wall Switches
 - 4. Handheld Remote Controls
 - 5. Room Controllers
 - 6. Digital Photosensors
 - 7. Room Network (DLM Local Network)
 - 8. Configuration Tools
 - 9. Network Bridge
 - 10. Segment Manager
 - 11. Emergency Lighting
 - 12. Source Quality Control

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements and Section 26 0000, Electrical Basic Requirements.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. Wattstopper DLM Series
- B. Lutron Quantum Series
- C. Douglas Lighting Controls Dialog Series
- D. Or approved equal.

2.2 GENERAL PERFORMANCE

- A. Daylight Harvesting and Occupant Detection to Control Lighting with the Following Hierarchy:
 - 1. Emergency (Highest Priority): ignores all other inputs
 - 2. Programming: During system programming, sensor inputs are ignored.
 - 3. Occupant Sensor: Allows lights to be on/off.
 - 4. Daylight Sensor: Imposes a high end limit for light output.

5. Personal Control: Fine tune light levels up to the daylight sensor limit.
- B. Response to a single sensor can be unique on luminaire by luminaire basis.
- C. Power failure recovery - All devices return to their previous light level prior to power loss.
- D. All programmable devices with integral power failure memory to maintain settings for a minimum of 10 hours during power loss.
- E. Wall station and sensor replacement accomplished without programming.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Wall or Ceiling mounted (to suit installation) dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the system accommodating the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, and accessories which suit the lighting and electrical system parameters.
- B. Digital Occupancy Sensors will provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton programming for the following variables:
 - a. Sensitivity: 0-100 percent in 10 percent increments.
 - b. Time delay: 1-30 minutes in 1 minute increments.
 - c. Test mode: Five second time delay.
 - d. Detection technology: PIR, Ultrasonic or Dual Technology activation and/or re- activation.
 - e. Walk-through mode.
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Two RJ-45 port(s) for connection to DLM local network.
 3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 4. Device Status LEDs including:
 - a. PIR Detection.
 - b. Ultrasonic detection.
 - c. Configuration mode.
 - d. Load binding.
 5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 6. Manual override of controlled loads.
- C. Units will not have any dip switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. Wattstopper product number: LMDC-100 or LMDX-100.

2.4 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, and 4 button configuration; available in white, light almond, ivory, grey, and black; compatible with wall plates

with decorator opening. Wall switches will include the following:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Red configuration LED on each switch that blinks to indicate data transmission.
 4. Blue Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED.
 - b. Dim locator level indicates power to switch.
 - c. Bright status level indicates that load or scene is active.
 5. Dimming switches will include seven bi-level LEDs to indicate load levels using 14 steps.
- B. Two RJ-45 ports for connection to DLM local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- D. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only, or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Face Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- E. Wattstopper product number: LMSW-101, LMSW-102, LMSW-103, or LMSW-104.

2.5 HANDHELD REMOTE CONTROLS

- A. Battery-operated handheld switches in 1, 2, and 5 button configuration for remote switching or dimming control. Remote controls will include the following features:
1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
 2. Blue LED on each button confirms button press.
 3. Load buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
 4. Inactivity timeout to save battery life.
- B. A wall mount holster and mounting hardware will be included with each remote control.
- C. Wattstopper product number: LMRH-101, LMRH-102, or LMRH-105.

2.6 ROOM CONTROLLERS

- A. Room controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room controllers shall be provided to match the room lighting load and control requirements. The controllers will

be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement - Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 3. Device Status LEDs to indicate:
 - a. Data transmission.
 - b. Device has power.
 - c. Status for each load.
 - d. Configuration status.
 4. Quick installation features including:
 - a. Standard junction box mounting.
 - b. Quick low voltage connections using standard RJ-45 patch cable.
 5. Plenum rated.
 6. Manual override and LED indication for each load.
 7. Dual voltage (120/277 VAC, 60 Hz).
 8. Zero cross circuitry for each load.
- B. On/Off/Dimming Enhanced Room Controllers shall include:
1. Real time current monitoring.
 2. Three relay configuration.
 3. Efficient 250 mA switching power supply.
 4. Four RJ-45 DLM local network ports.
 5. One 0-10 volt analog output per relay for control of compatible LED drivers.
 6. Network Bridge for BACnet MS/TP communications (LMRC-3xx).
 7. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100 percent.
 - b. Set high and low trim for each load.
 8. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - a. One relay configuration only.
 - b. Automatic ON/OFF configuration.
 9. Wattstopper product number: LMRC-213.

2.7 DIGITAL PHOTOSENSORS

- A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.
- B. Digital photosensors include the following features:
1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 2. Sensor light level range shall be from 1-10,000 footcandles (fc).
 3. The capability of switching one-third, one-half or all lighting ON and OFF, or

- raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.
 5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user- selectable minimum level.
 6. Programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
 7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
 8. Red configuration LED that blinks to indicate data transmission.
 9. Blue status LED indicates test mode, override mode and load binding.
 10. Recessed switch to turn controlled load(s) ON and OFF.
 11. One RJ-45 port for connection to DLM local network.
 12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

- C. Open loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
 2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
 3. A proportional control algorithm for dimming daylight harvesting with a "Setpoint" to be maintained during operation.
 4. Wattstopper product number: LMLS-500.

2.8 ROOM NETWORK (DLM LOCAL NETWORK)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:
1. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 3. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.9 CONFIGURATIONS TOOLS

- A. A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features

infrared communications, while PC software connects to each local network via a USB interface.

- B. Features and functionality of the wireless configuration tool shall include:
 - 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 - 3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers, and buttons on digital wall switches.
 - 4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
 - 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting.
 - 6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.

- C. Wattstopper product number: LMCT-100.

2.10 NETWORK BRIDGE

- A. The network bridge connects a DLM local network to a BACnet-compliant network for communication between rooms, panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication.
 - 1. The network bridge may be incorporated directly into the room controller hardware (LMRC-3xx Room Controllers) or be provided as a separate module connected on the local network through an available RJ-45 port.
 - 2. Provide Plug n' Go operation to automatically discover all room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 - 3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after hours schedule state for the room.
 - b. Read the detection state of the occupancy sensor.
 - c. Read/write the On/Off state of loads.
 - d. Read/write the dimmed light level of loads.
 - e. Read the button states of switches.
 - f. Read total current in amps, and total power in watts through the room controller.
 - g. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings.
 - h. Activate a preset scene for the room.
 - i. Read/write daylight sensor fade time and day and night setpoints.
 - j. Read the current light level, in footcandles, from interior and exterior photosensors and photocells.
 - k. Set daylight sensor operating mode.
 - l. Read/write wall switch lock status.
 - 4. Wattstopper product number: LMBC-300.

2.11 SEGMENT MANAGER

- A. The Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser. Each segment manager shall have support for one segment networks as required and allow for control of a maximum of 120 local networks (rooms) and/or lighting control panels per segment network.
- B. Operational features of the segment manager shall include the following:
1. Connection to PC or LAN via standard Ethernet TCP/IP.
 2. Easy to learn and use graphical user interface, compatible with Internet Explorer 11, or equal browser.
 3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Automatic discovery of all DLM devices on the segment network(s). Commissioning beyond activation of the discovery function shall not be required.
 5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
 6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation.
 7. Ability to set up schedules for rooms and panels. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation.
 8. Ability to group rooms and loads for common control by schedules, switches or network commands.
 9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
 10. Provide seamless integration with the BAS via BACnet IP.
- C. Wattstopper product number: LMSM-3E.

2.12 EMERGENCY LIGHTING

- A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating.
 2. Push to test button.
 3. Auxiliary contact for remote test or fire alarm system interface.
 4. UL2043 plenum rated.
- B. Wattstopper product number: ELCU-100, with EMTS-100 remote test switch.

2.13 SOURCE QUALITY CONTROL

- A. Perform full-function testing on all completed assemblies at end of line.
- B. Diagnostics and Service - Tiered control scheme for dealing with component

failure that minimizes loss of control for occupant.

1. Bus Failure: Lights go to emergency level for safety.
2. Failure of One Sensor Type: Ballast still controllable via other sensors.
3. Ballast Failure: Only impacts one fixture - remainder of system operates as programmed.

END OF SECTION

SECTION 26 0926

LIGHTING CONTROL PANELBOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General
 - 2. Networks

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric/Square D
- B. Eaton Electrical
- C. Or approved equivalent.
- D. Basis of Design: Lighting control panelboards designed based on Schneider Electric/Square D Powerlink product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including available space for equipment (including Code required working clearances) and functionality of system as described in Drawings and Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 GENERAL

- A. Lighting control system consists of microprocessor-based control electronics with remotely- operated circuit breakers mounted to UL67 listed lighting panelboard interior and enclosed in a UL50 listed panelboard enclosure. Circuit breakers provide overcurrent protection, and have an AIR rating or series connected rating that meets or exceeds fault current of system to which panelboard is being applied.
- B. Each master control panel meets or exceeds following capabilities:
 - 1. Sixteen 2-wire input terminals for connection to external low voltage switch contacts.
 - 2. Capable of remotely controlling 168 branch circuits in master/slave configuration.
 - 3. Provide true status feedback by monitoring branch circuit breaker status based on actual system voltage at load side terminal.
 - 4. Accept remote commands via network connection.
- C. Install lighting control components in a conventional panelboard 20-inches wide or column-width enclosures. Install suitable barriers to separate Class 2 wiring from power conductors.

2.3 NETWORKS

- A. Provide subnet wiring between master and slave panels as indicated on drawings. Subnet wiring permits slave panels to receive power and control data from master

panelboard. Connect no more than eight bus rails to subnet.

- B. Subnet communications follow Class 1 wiring practices. Communications conductors: Belden 27326 or equal having same voltage rating as branch circuit conductors. Wiring distances not to exceed manufacturer's recommendations.
- C. Communications wiring to master panels use Category 5 cabling. Coordinate work with network administrator to assure that proper connection points are available. Secure one static IP address for each master controller.

END OF SECTION

SECTION 26 1490

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Outdoor photoelectric switches.
 - 2. Switch-box occupancy sensors.
 - 3. Ceiling-mounted occupancy sensors.
 - 4. Modular Lighting Controller
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall switches and occupancy sensors.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.
- B. Modular Lighting Controller: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.
1. Contact Configuration: SPST.
 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 3. Program: Single channel 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 4. Programs: 24 channels.
 - a. For each channel, 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
 - b. For each channel, 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
 - c. For each channel, 40 on-off operations per week, plus 4 seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
 6. Astronomical Time: Selected channels for exterior lighting circuits.
 7. Battery Backup: For schedules and time clock.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers:
1. The WattStopper.
 2. Intermatic, Inc.
 3. Lithonia Lighting.
 4. Novitas, Inc.
 5. Square D.
 6. TORK.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc , with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
 2. Time Delay: 15-second minimum, to prevent false operation.

3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.4 OCCUPANCY SENSORS

- A. Manufacturers:
 1. The WattStopper.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting.
 4. Novitas, Inc.
 5. Hubbell Lighting Inc.
- B. General Description: Ceiling- mounting, solid-state units with a separate relay unit.
 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.
- C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on an 8-foot- (2.4-m-) high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

- D. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 26 Section "Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 22 AWG, complying with Division 26 Section "Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 16 AWG, complying with Division 26 Section "Conductors and Cables."
- D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 27.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

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SECTION 26 2413

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Switchboards
 - 2. Commercial Metering Switchboards
 - 3. Non-Utility Power Meters (Microprocessor-Based Metering Equipment)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Switchboards
 - 1. Eaton
 - 2. GE Industries
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- B. Commercial Metering Switchboards
 - 1. Eaton
 - 2. GE Industries
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- C. Non-Utility Power Meters (Microprocessor-Based Metering Equipment)
 - 1. Eaton
 - 2. GE Industries
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- D. Manufacturers listed above are allowed on condition of meeting specified conditions including available space for equipment, Code required working clearances, and both amps interrupting capacity (AIC). Prior to submitting bid, manufacturer to provide documentation to Engineer verifying specific conditions, including those mentioned above, can be met. Remove and replace electrical equipment installed, at no cost to the Owner, that does not meet these conditions.

2.2 SWITCHBOARDS

- A. Description: NEMA PB 2 freestanding switchboard with electrical ratings and configurations as indicated and specified.

- B. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated switchboards are not acceptable. Reference drawings for available fault current. If drawings do not have available fault current shown, then coordinate with serving electrical utility.
- C. Bus Material: Copper, standard size.
- D. Ground Bus: Extend length of switchboard, 50 percent of phase bus capacity.
- E. Neutral Bus: 100 percent rated, full length of switchboard.
- F. Lugs: Mechanical type for copper conductors.
- G. Fusible Switch Assemblies: NEMA KS 1, quick make, quick break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R fuses up to 600 amp.
 - 1. Provide switches of 30 to 200 amp with plug-on line side connections.
- H. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse clips: Designed to accommodate Class L fuses. Provide with shunt trip and ground fault capabilities.
- I. Molded Case Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole.
 - 1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 2. Include shunt trip where indicated.
- J. Solid-State Molded Case Circuit Breakers: With electronic sensing, timing and tripping circuits for adjustable current settings; UL listed.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time trip.
 - 4. Adjustable long time delay.
 - 5. Adjustable short time delay.
 - 6. Adjustable short time pickup.
 - 7. Stationary mounting.
 - 8. Include shunt trip where indicated.
- K. Circuit breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per CEC Article 240.87(B).
- L. Switchboard Circuit Breakers: Rated for 100 percent current flow upstream of branch circuit panelboards, including panelboards fed via intermediary step-down transformers.
- M. Ground Fault Sensor: Residual ground fault type.
- N. Metering Transformer Compartment: For utility company's use; compartment size, bus spacing and drilling, door, and locking and sealing requirements in accordance with utility company's requirements.
- O. Utility Pull Section:
 - 1. Width as shown on drawings. Depth and height to match switchboard.

2. Arrange as shown on drawings.
- P. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.
- Q. Pull Box: Removable top and sides, same construction as switchboard.
1. Size as shown on drawings.
 2. Provide insulating, fire-resistive bottom with separate openings for each circuit to pass into switchboard.
- R. Enclosure: NEMA Type 1 - Indoor.
1. Align sections as shown on drawings.
 2. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
 3. Removable front covers: Screw attached.
 4. Provide removable hinge pins on hinged doors.
 5. Provide full height barriers between sections.
 6. Mimic Bus: Showing bussing, connections and devices in single line form on the front panels of the switchboard.
 - a. Use blue factory painting.
 - b. Use plastic strips.
 - c. Fasten strips flat against the panel face with screws or rivets.
- S. Surge Protective Device: Provide for emergency distribution systems equipment as required per NEC Article 700.8.

2.3 COMMERCIAL METERING SWITCHBOARDS

- A. Comply with requirements of 2.02 above.
- B. Tested and UL Listed for use as multi-metering system.
- C. Meet EUSERC requirements.
- D. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated switchboards are not acceptable. Reference drawings for available fault current. If drawings do not have available fault current shown, then coordinate with serving electrical utility.
- E. Meter Sockets/Branch Devices:
1. Provide meter sockets per utility company requirements.
 2. Sockets rated 200 amp continuous duty.
 3. Prewired circuit breaker branch device meter socket combination.
 4. Provide thermostatically controlled electric heaters in each section, sized to prevent condensation under expected weather conditions at project site.
 5. Provide terminals for separate connection of heater power circuit.
- F. Circuit breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per CEC Article 240.87(B).

2.4 NON-UTILITY POWER METERS (MICROPROCESSOR-BASED METERING EQUIPMENT)

- A. Power Xpert Branch Circuit Monitor

1. Power monitoring shall be provided on all breakers within the main distribution switchgear.
2. The main breaker meter shall be Eaton PowerXpert 4000 or approved equal.
3. Sub breaker meters shall be Eaton Power IQ 250 or approved equal.
4. Power meters shall have certified revenue accuracy as per ANSI C12.20 and IEC60687 class 0.5S or better.
5. The meter and associated instrument transformers shall provide accuracy of +/- 1 percent over the range of 5 percent to 100 percent of rated current or voltage, +/-2 percent over the range of 5 percent to 100 percent of rated power.
6. Where shown on the drawings, supply a UL listed microprocessor-based Branch Circuit Monitoring System (PXBCM), or approved equal having the specified features. This system shall consist of meter base, and meter module(s) as described below.
7. The Branch Circuit Monitor shall measure the following operational data for up to 84 branch load circuits:
 - a. Forward and Reverse kWh.
 - b. Watts, VA, Amps, Power Factor.
 - c. Present and Peak demand readings for Amps, Forward and Reverse Watts.
 - d. Maximum Watts, VA, Amps.
8. The Branch Circuit Monitor shall support alarms for current that can be set based on percent of breaker rating and alarms for voltage based on percent of nominal voltage.
 - a. High, High-High, Low, Low-Low non-latching alarms for current.
 - b. High and Low latching alarms for current, resettable via Modbus or the WEB interface.
 - c. High and Low latching and non-latching voltage alarms for each meter module input voltage.
 - d. Alarm Status and alarm counters shall be available via Modbus communications.
9. Branch Circuit monitor shall support upgradeable firmware via communications.
10. The Branch Circuit Monitor shall have the following ratings:
 - a. Elevation: 0 to 9843 ft (0 to 3000M).
 - b. Pollution degree: 2 (IEC 60644-1).
 - c. Ambient temperature range: -20 degrees C to +70 degrees C (-4 degrees to +158 degrees F).
 - d. Storage temperature range: -40 degrees C to +85 degrees C (-40 degrees F to +185 degrees F).
 - e. Humidity: 5 percent to 95 percent non-condensing.
 - f. PXBCM as a component shall have a NEMA 1 rating. When installed in an enclosure it shall have the same rating as its enclosure NEMA 1.
 - g. Housing Ingress Protection: IP20 as a component, in an enclosure the same as the enclosure.
 - h. CE Mark.
 - i. EMC (Electromagnetic Compatibility):
 - 1) IEC61326: EMI IEC61000-4-X Level 3.
 - 2) CISPR 11: Class B emissions, CISPR 22 (Ethernet) class B emissions.
 - 3) FCC Part 15 Class B emissions.
 - j. UL/cUL 61010-1 3rd Edition.
 - k. EN61010-1.
11. PXBCM Meter Base:

- a. Each PXBCM-MB Meter Base shall support connection of up to 4 Meter Modules in either a MMS Strip or MME External configuration monitoring a total of up to 100 single-phase two-wire AC loads, 48 single-phase three-wire AC loads or 32 three-phase four-wire AC loads or combinations not to exceed 25 poles per meter module.
 - b. The PXBCM-MB shall be equipped with 4 meter module ports. Each port shall provide control power and communications to either a PXBCM-MMS Meter Module Strip or a PXBCM-MME Meter Module External with a maximum cable length of 28 feet between each Meter Base and each Meter Module.
 - c. Each PXBCM-MB shall support connection to up to 4 PXBCM-MMS Meter Module Strip or 4 PXBCM-MME Meter Module External, or a combination of up to 4 total PXBCM-MMS and PXBCM-MME each meter module with independent single or three phase voltage metering circuits with inputs up to 277V L-N and 480V L-L.
 - d. PXBCM-MB Power Supply shall be rated for 100-277VAC L:N +/-10% CAT III, 47- 63 Hz , 6W.
 - e. The PXBCM-MB shall include a 3 terminal RS-485 serial port for Modbus RTU communications and an RJ-45 port for Ethernet communications. The Ethernet port shall support Modbus TCP communications as well as an Embedded WEB server.
 - f. The PXBCM-MB embedded WEB server shall support device configuration for to up to 4 PXBCM-MMS Meter Module Strip or 4 PXBCM-MME Meter Module External, or a combination of up to 4 total PXBCM-MMS and PXBCM-MME and display of up to 100 points of metering data. It shall be possible to save device configuration information to a file for archiving and for uploading to PXBCM.
 - g. The PXBCM-MB shall support connection to a pre-configured HMI via RS-485 serial port. The HMI shall not require configuration.
 - h. The PXBCM-MB shall be equipped with LEDs to indicate communications activity and Device/Alarm Status. An LED shall also indicate if Ethernet is configured for DHCP (automatically assigned IP address) or Fixed IP (manually assigned IP address). The PXBCM-MB shall be equipped with 2 rotary switches to assign Modbus Slave ID 1-99.
 - i. The PXBCM-MB shall be equipped with security mode switches to enable the device to operate in a secure mode to prevent tampering with device configuration and resets over comms.
 - j. The PXBCM Meter Base shall automatically sense the type of PXBCM Meter Module connected to each of its 4 meter module ports.
 - k. The Configuration Wizard shall support naming and configuration of up to 100 virtual meters by assigning 1-3 channels of current to 1, 2 or 3 pole meters. Virtual meters shall aggregate the channel data assigned to each virtual meter and report the aggregated virtual meter values for:
 - 1) Forward and Reverse Energy.
 - 2) Watts, VA, Average Amps and Power Factor.
 - 3) Average and Peak demand for Watts and VA.
12. PXBCM-MMS Meter Module Strip:
- a. PXBCM-MMS Meter Module Strips shall be available in configurations to mount on either the left or right of a panelboard and contain 9, 15, or 21 CTs. Four additional 333mV connections shall be provided on each PXBCM-MMS for Auxiliary 333mV CT connections which can be used to monitor the panel mains or branch circuits. The MMS shall include both load current and voltage metering circuits providing meter data to the

- Meter Base.
- b. The PXBCM Meter Module Strip shall be available with either 9 CTs, 15 CT's or 21 CT's per assembly for factory assembly into Panelboards with 18, 30 or 42 poles. PXBCM MMS CTs shall have be rated for up to 100A continuous current monitoring and designed to mount in an Eaton PRL-1a, PRS-2a or PRL-3e Panelboard with 1 inch breaker pole spacing.
 - c. PXBCM Meter Module Strip 1 inch center CTs shall have a window opening sufficient for insulated Aluminum conductor rated for 100A capacity.
 - d. The PXBCM Meter Module Strip shall support direct connection of one set of 3 phase nominal metering voltage inputs up to 277V L-N and 480V L-L voltages and shall be rated as Cat III.
 - e. The Meter Modules can also monitor voltage in the following configurations:
 - 1) Three phase, four wire wye.
 - 2) Three phase, three wire delta.
 - 3) Three phase, center tapped delta.
 - 4) Three phase, three wire.
 - 5) Single phase, two wire.
 - f. Power and Energy metering shall be performed based on the voltage assignment for each 100A strip mounted CT and 333mV Aux CT current input as configured using the embedded WEB server.
 - g. PXBCM MMS Accuracy of kWh metering on branch circuits shall be rated for ANSI C12.20 0.5 accuracy class as a system, including 100A rated strip mounted solid core current transformers. kWh accuracy for 333mV input auxiliary circuits shall satisfy ANSI C12.20 0.5 class excluding external 333mV sensor performance.
 - h. The PXBCM MMS shall be UL approved for mounting to the panelboard interior with no interference. Strip placement shall line up 1 inch center CT's with breaker poles and not impede the normal routing of branch circuit conductors in the panel enclosure.
 - i. The PXBCM MMS shall connect to the PXBCM MB using factory supplied cables.
13. PXBCM-MME Meter Module External:
- a. The PXBCM-MME provides the same metering functionality as the PXBCM-MMS but is used for retrofit or non-uniform/high-mix load applications where the PXBCM-MMS strip mounted 100A CT's cannot be applied.
 - b. The PXBCM Meter Module external shall support 25 channels of current using external 333mV current sensors connected to terminal strips on the PXBCM-MME.
 - c. The PXBCM Meter Module External shall support direct connection of one set of 3 phase nominal metering voltage inputs up to 277V L-N and 480V L-L voltages and shall be rated as Cat III.
 - d. The Meter Modules can also monitor voltage in the following configurations:
 - 1) Three phase, four wire wye.
 - 2) Three phase, three wire delta.
 - 3) Three phase, center tapped delta.
 - 4) Three phase, three wire.
 - 5) Single phase, two wire.
 - e. Power and Energy metering shall be performed based on the voltage assignment for each 333mV current sensor input as configured using the embedded WEB server.

- f. PXBCM MMS Accuracy of kWh metering on 333mV input circuits shall satisfy ANSI C12.20 0.5 class excluding external 333mV sensor performance.
14. Optional HMI Display shall display data for all configured sub-meters.
- a. HMI configuration shall not be required for each sub-meter. The HMI shall discover the configuration information automatically.
 - b. Displayed information shall include:
 - 1) Sub-meter name, current, voltage, energy consumption, demand, and power factor for up to 100 load circuits.
 - 2) Aggregated Power and Energy readings for any 1, 2 or 3 pole meters.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Power Distribution Panelboards
 - 2. Panelboards

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Power Distribution Panelboards:
 - 1. Eaton
 - 2. General Electric
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- B. Panelboards:
 - 1. Eaton
 - 2. General Electric
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- C. Manufacturers listed above are allowed on condition of meeting specified conditions including available space for equipment, Code required working clearances, and both amps interrupting capacity (AIC). Prior to submitting bid, manufacturer to provide documentation to Engineer verifying specific conditions, including those mentioned above, can be met. Remove and replace electrical equipment installed, at no cost to the Owner, that does not meet these conditions.

2.2 POWER DISTRIBUTION PANELBOARDS

- A. Description: NEMA PB 1 Type 1 or as indicated on drawings, circuit breaker type.
- B. Circuit breakers in distribution panels to be rated for minimum 42,000A RMS symmetrical interrupting capacity or as indicated on drawings. Where the required interrupting capacities, according to the Overcurrent Protection Devices Coordination Study, are higher than those
- C. indicated in items above, the equipment selected must provide these higher interrupting capacities. As per Section 26 00 00, Electrical Basic Requirements, submit the Protection Coordination Study with the first set of shop drawings on switchgear and panelboards.

- D. Panelboard Bus: Non-reduced copper, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- E. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- F. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- G. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.
- H. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole: UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- I. Solid-State Molded Case Circuit Breakers: With electronic sensing, timing and tripping circuits for adjustable current settings; UL listed.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time trip.
 - 4. Adjustable long time delay.
 - 5. Adjustable long time pickup.
 - 6. Adjustable short time delay.
 - 7. Adjustable short time pickup.
 - 8. Stationary mounting.
 - 9. Include shunt trip where indicated.
- J. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- K. Circuit Breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per CEC Article 240.87(B).
- L. Fully equip unused spaces for future devices, including manufacturer required connections and mounting hardware.
- M. Cabinet Front: Surface type hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.
- N. Surge Protective Device: Provide for emergency distribution systems equipment as required per NEC Article 700.8.

2.3 PANELBOARDS

- A. Description: Panelboards 400 amps or less. NEMA PB1, Type 1 or as indicated on drawings, circuit breaker type. Maximum enclosure depth: 6-inches for surface mounted, 5-3/4-inches for flush mounted.
- B. Maximum Width: 20-inches.

- C. Circuit breakers in branch circuit panels to be rated for minimum 22,000A RMS symmetrical interrupting capacity or as indicated on drawings. Where the required interrupting capacities, according to the Overcurrent Protection Devices Coordination Study, are higher than those indicated in items above, the equipment selected must provide these higher interrupting capacities. As per Section 26 00 00, Electrical Basic Requirements, submit the Protection Coordination Study with the first set of shop drawings on switchgear and panelboards.
- D. Panelboard Bus Non-Reduced: Copper, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- E. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- F. Provide double lugs and/or feed-through lugs for feed through feeders.
- G. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for poles; UL listed. Predrill bus for bolt-on breakers.
 - 1. Type SWD for lighting circuits.
 - 2. Type HACR for air conditioning equipment circuits.
 - 3. Class A ground fault interrupter circuit breakers where scheduled.
 - 4. Class B ground fault equipment protection circuit breakers for heat trace and other circuits as required by Code. Provide shunt trip circuit breakers where scheduled; provide wiring to remote trip switch/contacts as indicated on Drawings.
 - 5. Do not use tandem circuit breakers.
 - 6. AFCI Circuit Breaker: UL 489 and 1699 compliant. Manual test button for AFCI mechanism. Self-testing, tripping if AFCI module fails. Cause of trip indication to the AFCI requirements.
 - 7. Dual Function (AFCI/GFCI) Circuit Breaker: UL 489, 493 and 1699 compliant. Integral Class A 5mA GFCI trip. Manual test button for AFCI mechanism. Self testing, tripping if AFCI module fails.
- H. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole; UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- I. Solid-State Molded Case Circuit Breakers: With electronic sensing, timing and tripping circuits for adjustable current settings; UL listed.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time trip.
 - 4. Adjustable long time delay.
 - 5. Adjustable long time pickup.
 - 6. Adjustable short time delay.
 - 7. Adjustable short time pickup.
 - 8. Stationary mounting.
 - 9. Include shunt trip where indicated.
- J. Accessories: Provide where indicated: shunt trip, arc-fault circuit interrupter

(AFCI), Class A ground fault circuit interrupter (GFCI), auxiliary switch, and alarm switch.

- K. Cabinet Front: Provide flush or surface mounting as shown on the schedules, drawings, or otherwise noted. Cabinet front with concealed hinged front cover construction, metal directory frame with heavy clear plastic protector, flush lift latch and lock, two keys per panel all keyed alike.
- L. Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
- M. Furnish surface mounted cabinet boxes without knockouts.
- N. Surge Protective Device: Provide for emergency distribution systems equipment as required per NEC Article 700.8.

END OF SECTION

SECTION 26 2716

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Hinged Cover Enclosures
 - 2. Cabinets
 - 3. Terminal Blocks
 - 4. Accessories

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hinged Cover Enclosures:
 - 1. Cooper B-Line
 - 2. Qube Corporation
 - 3. Robroy Industries
 - 4. Circle AW
 - 5. Hoffman
 - 6. Wiegmann
 - 7. Or approved equivalent.
- B. Cabinets:
 - 1. Hoffman
 - 2. Circle AW
 - 3. Cooper B-Line
 - 4. Or approved equivalent.
- C. Terminal Blocks:
 - 1. Allen-Bradley/Rockwell Automation
 - 2. Cooper Bussmann
 - 3. WECO Electrical Connectors Inc.
 - 4. Or approved equivalent.
- D. Accessories:
 - 1. Cooper B-Line
 - 2. Rob Roy
 - 3. Qube Corporation
 - 4. Or approved equivalent.

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1 steel enclosure.

- B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver, key, or thumb latch.
- C. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.
- E. Keys: Provide two of each different key.

2.3 CABINETS

- A. Boxes: Galvanized Steel, Plastic, Fiberglass, or Stainless Steel.
- B. Box Size: As noted on drawings.
- C. Backboard: Provide 3/4-inch thick plywood backboard for mounting terminal blocks. Paint matte white.
- D. Fronts: Steel, flush type with concealed trim clamps, door with concealed hinge, and flushlock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Provide metal barriers to form separate compartments for wiring of different systems and voltages.
- F. Provide accessory feet for free-standing equipment.
- G. Keys: Provide two of each different key.

2.4 TERMINAL BLOCKS

- A. Terminal Blocks: NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Provide ground bus terminal block, with each connector bonded to enclosure.

2.5 ACCESSORIES

- A. Plastic Raceway: Plastic channel with hinged or snap-on cover.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
 - 1. Wall Switches
 - 2. Receptacles
 - 3. Finish Plates
 - 4. Wall Dimmers
 - 5. Surface Covers

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wall Switches:
 - 1. Decorative AC Rocker Switch Characteristics:
 - a. Cooper
 - b. Hubbell
 - c. Leviton
 - d. Legrand P&S
 - e. Or approved equivalent.
- B. Receptacles:
 - 1. Industrial Grade:
 - a. Cooper 5362
 - b. Hubbell HBL5362
 - c. Bryant BRY5362
 - d. Leviton 5362
 - e. Legrand P&S 5362A
 - f. Or approved equivalent.
 - 2. Commercial Grade:
 - a. 20 Amp:
 - 1) Cooper 5362
 - 2) Hubbell 5362
 - 3) Bryant CBRS20
 - 4) Leviton 5362S
 - 5) Legrand P&S 5362
 - 6) Or approved equivalent.
 - 3. Ground Fault Circuit Interrupter (GFCI) Receptacle - 20 Amp:
 - a. Cooper WRSGF20W
 - b. Hubbell GFR5362SGW
 - c. Legrand P&S 2097TRWR
 - d. Or approved equivalent.

- C. Finish Plates:
 - 1. Bryant
 - 2. Cooper
 - 3. Hubbell
 - 4. Leviton
 - 5. Legrand P&S
 - 6. Or approved equivalent.
- D. Wall Dimmers:
 - 1. Lutron Maestro Series
 - 2. Or approved equivalent.
- E. Surface Covers:
 - 1. Aluminum with Gasket, Blanks, Single Gang:
 - a. Bell 240-ALF
 - b. Carlon
 - c. Or approved equivalent.
 - 2. 2-Gang:
 - a. Bell 236-ALF
 - b. Carlon
 - c. Or approved equivalent.
 - 3. While-in-Use Weatherproof Cover:
 - a. Die Cast Cover:
 - 1) Intermatic
 - 2) Hubbell
 - 3) Cooper
 - 4) Or approved equivalent.
- F. Provide lighting switches and receptacles of common manufacturer and appearance.

2.2 WALL SWITCHES

- A. Characteristics: Decorative AC Rocker Switch Characteristics: Quiet acting, 20 amp, 120/277 volt, UL Listed for motor loads up to 80 percent of rated amperage.
- B. Timer Switches: Digital time switch to automatically turn light off after set time. Adjustable time setting from five minutes to 12 hours. LCD to show time remaining. 20-amp/120 to 277 volt.
- C. Momentary Center Off: Toggle type, quiet acting, 20-amp/120/277 volt, double throw momentary contact, center off position.
- D. Pilot Light Switches: Lighted handle, toggle type, red unless noted otherwise, neon pilot lamp. Pilot lamp energized when load is energized. 20 amp/120, 208 and 277 volt.
- E. Lighted Handle Switches: Lighted handle, quiet acting, 20 amp, 120/277 volt, toggle type, red unless noted otherwise neon lamp. Lamp energized when load is not energized.
- F. Key Switches: 20 amp/120-277 volt, black key guide.
- G. Finish: White.
- H. Plug-Tails: Switches that use a plug-tail or snap-on connector are allowed;

switches installed that do not meet these specifications (example: switch with plug-tails installed that is not fully rated for 20 amps load) are subject to removal and replacement at no cost to the Owner.

2.3 RECEPTACLES

- A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.
 - 1. Commercial Grade: Riveted. Back and side wired. Brass ground contact on steelstrap. Nylon face and nylon base. 20 amp.
- B. Isolated Ground Receptacle: Isolated ground "delta" on receptacle face, same finish as standard duplex receptacles, 20 amp.
- C. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125VAC.
- D. Surge Protector Receptacle: Feed-through type, back and side wired, 20 amp, 125VAC, LED monitor light, MOV protection in L-N, L-L, and N-G modes for up to 9000 amp surges. Minimum 170 joule rating.
- E. Specification Grade Tamper-Resistant Receptacle: 20 amp, 125VAC, complies with CEC requirements.
- F. Specification Grade Plug Load Duplex Receptacle: 20A, 125V, Decora style duplex receptacle, straight blade, hot terminal split with 1 plug controlled, self grounding. Back and side wired.
- G. Special Purpose Receptacles: Reference Drawings for NEMA Standard Specification.
- H. Finish:
 - 1. Same exposed finish as switches.
 - 2. Receptacles connected to emergency circuits life safety and critical to have red finish.
 - 3. Receptacles installed in surface raceway to match raceway finish. See Section 26 05 33, Raceways.
 - 4. All automatically controlled, nonlocking type, 125 volt, 15 amp and 20 amp rated receptacles to be permanently marked by the manufacturer with the "universalpower" symbol and the word "controlled."
 - 5. Receptacles connected to isolated ground to have orange finish.
- I. Plug-Tails: Receptacles that use a plug-tail or snap-on connector are allowed; receptacles installed that do not meet these specifications (example: GFCI outlet with plug-tails installed that does not have UL self-test ability or is not weather or tamper resistant) are subject to removal and replacement at no cost to the Owner.

2.4 FINISH PLATES

- A. Finish Plates: Type 302 stainless steel with smooth satin finish.
- B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.
- C. Provide emergency devices with factory engraved "Emergency."

2.5 WALL DIMMERS

- A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, low voltage, 2- wire, 3-wire, 0-10v). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.
- B. LED indicator dots show by what percentage controlled lighting is dimmed. Programmable settings for maximum and minimum trim settings, and rate of change in lighting levels.

2.6 SURFACE COVERS

- A. Material: Galvanized steel, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.
- B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single gang or 2-gang.
- C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
 - 1. UV stabilized polycarbonate cover with closed cell neoprene foam gasket.
 - 2. Thermoplastic cover with closed cell neoprene gasket.
 - 3. Die cast cover with closed cell neoprene foam gasket: Capable of being locked closed to prevent tampering or unauthorized use.

END OF SECTION

SECTION 26 4200

CATHODIC PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies complete galvanic sacrificial anode type cathodic protection systems for underground steel tanks and piping. The section also includes devices to electrically isolate the system being protected.
- B. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water, Fire Protection and Natural Gas line piping and above-ground appurtenances. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing the water or fire protection pipe shall have a test station.

1.2 RELATED WORK

- A. Section 33 1000, WATER SYSTEMS
- B. Section 33 5000, NATURAL GAS DISTRIBUTION PIPING

1.3 QUALITY ASSURANCE

- A. The Contractor shall be regularly engaged in the installation and testing of cathodic protection systems. Contractor's personnel shall be experienced and shall be supervised by an engineer who is accredited as a Corrosion Specialist or Cathodic Protection Specialist by the National Association of Corrosion Engineers (NACE) International.
- B. Cathodic protection for underground metal piping tanks shall be designed in accordance with NACE SP0169-2013.

1.4 SUBMITTALS

- A. In accordance with the following requirements:
 - 1. Design Submittal: For cathodic protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the corrosion engineer responsible for their preparation.
 - a. Conduct site tests necessary for design, including soil resistivity, close-interval potential surveys, testing during construction, interference testing, and training of District's personnel.
 - b. Provide system design calculations, stating the maximum recommended anode current output density, and the rate of gaseous production, if any, at that current density.
 - 2. Furnish catalog cuts and shop drawings for the following items:
 - a. Anodes.
 - b. Cable and wire.
 - c. Test stations.
 - d. Terminal boxes.
 - e. Isolating flanges, unions, coatings, casing seals.
 - f. Exothermic welding devices.

- g. Cable splice kits.
- h. Layout drawings, wiring diagrams.
- i. Test instruments.
- j. Dielectric tape.
- k. Test connection points.
- 3. Detail drawings consisting of a complete list of equipment and material and complete wiring and schematic diagrams, as well as any other details required to demonstrate that the system will function properly.
- 4. Designer's accreditation as a Corrosion Specialist or Cathodic Protection Specialist by NACE International.
- 5. Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, casing and interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.
- 6. Operation and Maintenance Manual:
 - a. Basic system operation.
 - b. Instructions for dielectric connections, interference and sacrificial-anode bonds; and precautions to ensure safe conditions during repair of pipe, tank or other metallic systems.
 - c. Locations of all anodes, test stations, and insulating joints.
 - d. Structure-to-reference cell potentials.
 - e. Recommendations for maintenance testing, including instructions for pipe-to-reference cell potential measurements and frequency of testing.
 - f. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 7. Certifications: Two weeks prior to final inspection, submit the following:
 - a. Certification by the manufacturer that the cathodic protection system conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the Cathodic protection system has been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - B8-11 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - B843-13 Magnesium Alloy Anodes for Cathodic Protection
 - D1248-12 Polyethylene Plastic Extrusion Materials for Wire and Cable
 - F1182-13 Anodes, Sacrificial Zinc Alloy
 - G57-06 Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method
- C. American Society of Mechanical Engineers (ASME):
 - B16.1-15 Pipe Flanges and Flanged Fittings

D. National Association of Corrosion Engineers (NACE) International:

SP0169-2013..... Control of External Corrosion on Underground or Submerged Metallic Piping Systems

PART 2 - PRODUCTS

2.1 ANODES

A. Type: Type II, factory-packed in cloth bag or box containing prepared backfill mixture, with lead wires.

B. Construction:

1. Alloy Specifications:

Element	Percent of Weight
Aluminum	0.010 Max.
Manganese	0.50 - 1.30
Zinc	0.05 Max.
Silicon	0.50 Max.
Copper	0.02 Max.
Nickel	0.001 Max.
Iron	0.03 Max.
Other	0.30 Max.
Magnesium	Remainder

2. Core: Galvanized steel.

3. Lead Wire: Factory installed, No. 12 solid copper, 3 M (10 feet) long, with TW or THWN insulation.

4. Lead Wire Attachment to Core: Silver solder the lead wire to the anode core, and seal the connection with an epoxy sealing compound. Dielectric material shall extend past the connection and cover the lead wire insulation by not less than 12 mm (1/2 inch).

5. Packaging: Permeable cloth bag o

a. Components:

Hydrated Gypsum	75 percent
Powdered Bentonite	20 percent
Anhydrous Sodium Sulphate	5 percent

b. Center the anode in the firmly packed backfill using spacers.

2.2 INSULATED CABLE

A. Single conductor, stranded, annealed copper, Type HMWPE (high molecular weight polyethylene) insulation.

B. Construction:

1. Thickness of insulation:

AWG-SIZE	mm (inches)
No. 8	2.8 (7/64)
No. 6	2.8 (7/64)
No. 4	2.8 (7/64)
No. 2	2.8 (7/64)
No. 1	3.2 (8/64)
No. 1/0	3.2 (8/64)

- 2. Insulation: ASTM D1248, Type 1, Class C, Category 5, Grade E5.
- 3. Conductors: ASTM B8.

C. Lead wires terminating at a junction box or test station shall have a cable identification tag.

2.3 CABLE CONNECTIONS

- A. Connections between cables and tank, pipes, casings, or structures shall be exothermic welding process. Connections between cables and between cables and leads shall be corrosion-resistant split bolts.
- B. Insulation of Cable-to-Cable Connections: Epoxy-resin splice kits with two-part resin, mold, sealing mastic.
- C. Coating of Cable Connections to Protected Structures: Field-applied coating similar to that on the protected structure.

2.4 CABLE AND WIRE IDENTIFICATION TAGS

- A. Stainless steel material with engraved letters. Print letters and numbers a minimum of 5 mm (3/16 inch) in size. Provide identifier legend in accordance with the drawings.

2.5 TEST STATIONS

- A. Type: Weatherproof, located at grade, or aboveground if so shown on the drawings. Enclosed terminals for anode leads, test leads, leads attached to protected system, and connection points for test instruments.
- B. Construction:
 - 1. Housing: The unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with locking cover, terminal board, shunts, and brass or stainless steel hardware.
 - 2. Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic. Insulated terminal boards shall have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper bus bars, shunts, and variable resistors on the terminal board as indicated. Test station terminal connections shall be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, and reference electrodes). Conductors shall be permanently identified by means of tags to indicate termination. Each conductor shall be color coded as follows:

Anode lead wire - black

Structure lead wire – white

Reference electrode lead wire - red

2.6 PERMANENT REFERENCE ELECTRODES

- A. Permanent reference electrodes shall be zinc specifically manufactured for underground use, 10 inch diameter, by 24 inches long, plastic tube with an ion trap to minimize contamination of the cell. The cell shall be prepackaged by the manufacturer with a backfill material as recommended by the manufacturer. Provide cells with No. 14 HMWPE cable of sufficient length to extend to the test station without splicing. Reference electrodes shall have a minimum 15 year life, and stability of plus or minus 5 millivolts under 3 microampere load.

2.7 DIELECTRIC TAPE

- A. Vinyl plastic electrical tape, 0.18 to 0.25 mm (7 - 10 mils) thick, pressure-sensitive adhesive.

2.8 WARNING TAPE

- A. 50 mm (2 inches) wide, detectable with metal detector, mylar-encased aluminum, orange color, imprinted "Cathodic Protection Cable Below" or similar.

2.9 DIELECTRIC INSULATION

- A. Rubber-based, 13 mm (0.5 inch) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Anodes:
 - 1. Excavate hole to a minimum 3 inches larger than the packaged anode diameter, and a minimum of two feet deep. Install in native soil, 3 feet minimum from protected structure, below centerline of protected structure, and at locations shown. Backfill shall be native soil. Install anodes adjacent to fuel tanks vertically.
 - 2. Do not lift or support anode by the lead wire. Where applicable, remove manufacturer's plastic wrap/bag from the anode. Exercise care to preclude damaging the cloth bag and the lead wire insulation.
 - 3. Center the packaged anode in the hole with native soil in layers not exceeding 150 mm (6 inches). Hand tamp each layer to remove voids taking care not to strike the anode lead wire. When the backfill is 6 inches above the top of the anode, pour not less than ten gallons of water into the hole to saturate the anode backfill and surrounding soil. Anodes shall not be backfilled prior to inspection and approval by the IOR.
- B. Cables and Anode Leads:
 - 1. Burial: 2 feet minimum below finished grade, 6 inches minimum separation from other underground structures, backfill material in contact with cable free of rocks and debris. Cover the lead wire trench bottom with a 3 inch layer of sand or stone free earth. Center wire on the backfill layer, do not stretch or kink the conductor. Place backfill over wire in layers not exceeding 6 inches deep and compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in backfill. Place cable warning tape within 18 inches of finished grade, above cable and conduit.
 - 2. Continuity Bonds: Use cable to connect adjacent protected structures, and protected structures separated by non-welded connectors. Provide 25 percent additional length as slack to allow differential movement of protected systems.
 - 3. Connections: Provide clean, bright, bare metal surface at all connection points. Connect anode lead wire(s) to the test station terminal board(s) by use of exothermic welds. Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright surface. Weld connections using exothermic kit(s) in accordance with the kit manufacturer's instructions. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 2 pound hammer. Cover connections with

an electrically insulating coating which is compatible with the existing coating on the structure. Allow sufficient slack in the lead wire to compensate for movement during backfilling operation.

4. Warning Tape: Install 6 inches below grade, directly above cables.
- C. Test Stations: Provide test stations and permanent reference electrodes as follows:
 1. At all above-ground water, fire water and natural gas appurtenances.
 2. At all insulating joints.
 3. At both ends of casings.
 4. Where the pipe crosses any other pipes.
 5. Where the pipe connects to an existing piping system.
 6. Where the pipe connects to a dissimilar metal pipe.
- D. Anchor terminal board firmly 2 feet minimum above grade for above grade units. Connect all anodes and protected structure to the test stations.
- E. Dielectric Insulation:
 1. General: Provide complete dielectric insulation between protected and unprotected systems and between protected systems and structures which could ground the cathodic protection. Required insulation points include all pipe entrances to buildings, manholes, and pits.
 2. Flanges: Install in locations open to view after completion of construction. Provide insulating gaskets, insulating sleeves on all bolts, insulating washers under bolt heads and nuts.
 3. Unions: Install in locations open to view after completion of construction. Unions not permitted in pipe sizes over 2 inches.
 4. Wall Penetration Seals: Install in space between pipes and wall sleeves at building and manhole walls.
 5. Coatings: Completely coat all pipe or conduit areas that are in contact with concrete.
- F. Permanent Reference Electrode Calibration and Installation:
 1. Provide zinc reference electrode(s) as indicated on the drawings.
 2. Prior to installation, soak the prepackaged reference electrode in a container of potable water for 30 minutes.
 3. Calibrate the permanent reference electrode in the presence of the IOR measuring the potential difference between the permanent reference electrode and an independent (portable) calibrated reference electrode placed in the water adjacent to the permanent reference electrode. Potential differences between the two electrodes of the same generic type should not exceed 15 millivolts when the sensing windows of the two electrodes being compared are not more than 2 mm (1/16 inch) apart but not touching. Zinc permanent reference electrodes should be within the range of 1000 to 1150 millivolts when calibrated with an independent (portable) calibrated copper-copper sulfate reference electrode with the two electrodes being not more than 2 mm (1/16 inch) apart but not touching. Permanent reference electrodes not within these potential differences shall be removed and replaced at the Contractor's expense. Prior to completely backfilling over reference electrodes, again verify the accuracy of the reference electrode. The testing provision shall also apply to replacement reference electrodes as well.

3.2 RECONDITIONING OF SURFACES

- A. Restoration of disturbed surfaces in kind, or as shown in the contract documents.

3.3 FIELD QUALITY CONTROL

- A. Provide system with a calculated design life exceeding 40 years.

- B. Pre-construction Survey: The Corrosion Specialist shall perform a soil resistivity survey using the Wenner Four-Pin Method as described in ASTM G57. Survey entire length of proposed protected system at the structure depth. Also survey native-state structure-to-soil potential, soil pH, and presence of stray currents.
- C. Calculations: The Corrosion Specialist shall perform engineering calculations to verify the design of the system shown. Inform the Government of any recommended changes in the system design shown.
- D. Field Inspections During Construction: The corrosion specialist shall inspect the work at least twice to ascertain that there is no grounding, short circuits, coating damage, and that installation is in accordance with requirements.
- E. Final Inspection:
 - 1. Performed by Corrosion Specialist; witnessed by IOR.
 - 2. Test Instruments:
 - a. Digital Volt-Ammeter with impedance of 7-10 mega-ohms/volt.
 - b. Saturated copper-copper sulfate reference electrode.
 - c. Other instruments as required.
 - 3. Procedures: Conform to NACE RP0169.
 - 4. Test Results Required for Acceptance:
 - a. Potential of minus 0.85 volt between protected structure and reference electrode.
 - b. Minimum shift of minus 300 millivolts upon application of protective current. Voltage measured between protected structure and reference electrode.
 - c. Minimum shift of minus 100 millivolts upon interruption of protective current. Voltage measured between protected structure and reference electrode.
 - d. Amperage value sufficient that anode life 40 years can be calculated. Provide calculations.
 - 5. Test Report: Submit a complete report to IOR showing all test measurements, calculations, list of instruments used. All structure-to-electrolyte measurements, including initial potentials and anode outputs, shall be recorded on applicable forms. Identification of test locations, test station and anode test stations shall coordinate with the as-built drawings and be provided on system drawings included in the report. The contractor shall locate, correct, and report to the IOR any short circuits encountered during the checkout of the installed cathodic protection system.
 - 6. One Year Warranty Period Testing: The Contractor shall inspect, test, and adjust the cathodic protection system semi-annually for one year, 2 interim inspections total, to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon the completion of all cathodic protection work, including changes required to correct deficiencies identified during initial testing, and preliminary acceptance of the cathodic protection system by the IOR. Copies of the One Year Warranty Period Cathodic Protection System Field Test Report, including field data, and certified by the Contractor's corrosion engineer shall be submitted to the IOR.

3.4 AS-BUILT DRAWINGS

- A. Provide the District with one set of as-built drawings in hard copy and CD Rom showing dimensioned locations of all anodes, cables, test stations, and anode weights. Provide identification of test stations and anodes keyed to test reports.

3.5 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one 4-hour period to instruct personnel in the operation, maintenance, safety, and emergency procedures of the cathodic protection system on the date requested by the District. The instructions shall cover all items contained in the operation and maintenance manual.

END OF SECTION

SECTION 26 4760

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches – Heavy duty.
 - 2. Nonfusible switches – Heavy duty.
 - 3. Molded-case circuit breakers.
 - 4. Molded-case switches.
 - 5. Enclosures.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 26 Section "Electrical Supports and Seismic Restraints." Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports including the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Manufacturer's field service report.
- G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures, Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Spares: For the following:
 - a. Potential Transformer Fuses: 6.
 - b. Control-Power Fuses: 6.
 - c. Fuses and Fusible Devices for Fused Circuit Breakers: 12.
 - d. Fuses for Fusible Switches: 6.
 2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES – HEAVY DUTY

- A. Manufacturers:
 1. Eaton Corporation.
 2. General Electric Co.; Electrical Distribution & Control Division.
 3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Fusible Switch, 600A and Smaller: NEMA KS 1, Type GD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 600A and Smaller: NEMA KS 1, Type GD, lockable handle with ept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.

3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers:
 1. Eaton Corporation.
 2. General Electric Co.; Electrical Distribution & Control Division.
 3. Moeller Electric Corporation.
 4. Siemens Energy & Automation, Inc.
 5. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- E. Molded-Case Switch Accessories:
 1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Electrical Supports and Seismic Restraints," and concrete materials and installation requirements are specified in Division 3.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Electrical Supports and Seismic Restraints."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.

2. Verify switch and relay type and labeling verification.
 3. Verify rating of installed fuses.
 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- E. Perform the following field tests and inspections and prepare test reports:
1. Test mounting and anchorage devices according to requirements in Division 26 Section "Electrical Supports and Seismic Restraints."
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Infrared Scanning:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
 - b. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
 - c. Instruments, Equipment and Reports:
 - d. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - e. Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 26 5100

LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Luminaires
 - 2. LED Drivers
 - 3. Lamps
 - 4. Lighting Poles

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires:
 - 1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 - 2. Or approved equivalent.
- B. LED Drivers:
 - 1. Indoor Drivers:
 - a. eldoLED Series
 - b. Advance/Philips
 - c. Osram Sylvania
 - d. Or approved equivalent.
 - 2. Outdoor Drivers:
 - a. Advance/Philips
 - b. Osram Sylvania
 - c. LG
 - d. Or approved equivalent.
- C. Lamps:
 - 1. LED (Light Emitting Diode) Lamps:
 - a. Nichia
 - b. Cree
 - c. Osram Sylvania
 - d. GE Lumination
 - e. Or approved equivalent.
 - 2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
 - 3. Special types as indicated in Luminaire Schedule.
 - 4. Or approved equivalent.
- D. Lighting Poles:
 - 1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 - 2. Or approved equivalent.

2.2 LUMINAIRES

- A. Luminaires: Reference description and manufacturers in Luminaire Schedule on drawings.
- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.
- D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.
- E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.
- F. Finishes:
 - 1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
 - 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
 - 3. Exterior Finishes: As detailed in Luminaire Schedule or on drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- G. Light Transmitting Components:
 - 1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 - 2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.
- H. LED Luminaires:
 - 1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
 - 2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.
 - 3. Standards: ANSI C78.377, LM-79 and LM-82 compliant for performance characteristics, photometry, colorimetry, efficacy and thermal characteristics.
 - 4. LM-80 + TM-21: Testing and measurement, and statistical prediction of LED lamp life. Report provided by DOE certified independent testing laboratory.
 - 5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
 - 6. Provide luminaires with integral LED thermal management system (heat sinking).
 - 7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.

8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

2.3 LED DRIVERS

A. General:

1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
4. Limit inrush current to minimize breaker tripping.
 - a. Base specification: NEMA 410 standard for inrush current for electronic drivers.
 - b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
7. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.
8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 55V.
 - b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
 - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.
10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.

B. Light Quality:

1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
 - a. Driver must be capable of 20 bit dimming resolution for white light

- LED drivers or 15 bit resolution for RGBW LED drivers.
2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
 3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
 4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100 percent to 0.1 percent luminaire will have:
 - a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
 - b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
 - c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.
- C. Control Input:
1. Provide control protocol to match lighting control system specified for use with luminaire.
 2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - a. Meet IEC 60929 Annex E for General White Lighting LED drivers.
 - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - c. Meet ESTA E1.3 for RGBW LED drivers.

2.4 LAMPS

- A. Provide lamps for luminaires.
- B. Provide lamp catalogued for specified luminaire type.
- C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.
- D. LED (Light Emitting Diode):
 1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
 - a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
 - b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
 - c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
 - d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
 - e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
 - f. Dimming: LED system capable of full and continuous dimming.
 - g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature

range for each nominal CCT.

- 1) Nominal CCT:
 - (a) 2700 K (2725 ± 145)
 - (b) 3000 K (3045 ± 175)
 - (c) 3500 K (3465 ± 245)
 - (d) 4000 K (3985 ± 275)

h. Color Rendering Index (CRI) to be greater than or equal to 80.

2. Special types as indicated in Luminaire Schedule.

2.5 LIGHTING POLES

- A. Provide exterior light poles, with concrete bases or direct buried, which are structurally supportive of pole under design loading.
- B. Provide exterior poles clean and scratch free with base bolt covers to match pole and luminaire finish.
- C. Provide poles and pole bases rated for a minimum of 100 MPH, unless otherwise noted. Wind EPA loading for quantity and type of luminaire it supports with a 1.3 gust factor.
- D. Provide poles with gasketed handholes, stainless steel tamper resistant hardware, anchor bolts and ground lugs.
- E. Description:
 1. Material: Steel, Aluminum, Treated wood, or Concrete.
 2. Shape: Tapered round, Round, or Square.
 3. Finish: Galvanized, Primed for field painting, or Anodized.
 4. Base: Embedded, Anchor, or Transformer.
 5. Accessories: Slipfitter and Mast Arms.

END OF SECTION

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SECTION 27 0500

COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes, but is not necessarily limited to:
1. Common standards and procedures for the Communications Work.
 2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Communications Systems. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.
- B. Provisions of this Section apply to Communications Work, including the following Sections:
1. Section 27 05 26 – Grounding and Bonding for Communications Systems
 2. Section 27 05 29 – Hangers and Supports for Communications Systems
 3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
 4. Section 27 05 36 – Cable Trays for Communications Systems
 5. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
 6. Section 27 05 53 – Identification for Communications Systems
 7. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
 8. Section 27 11 13 – Communications Entrance Protection
 9. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
 10. Section 27 11 19 – Communications Termination Blocks and Patch Panels
 11. Section 27 11 23 – Communications Cable Management
 12. Section 27 11 26 – Communications Rack Mounted Power Protection and Power Strips
 13. Section 27 13 00 – Communications Indoor Backbone Cabling
 14. Section 27 15 00 – Communications Horizontal Cabling

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
1. ANSI/TIA/EIA-568-C.1-2009 Commercial Building Telecommunications Cabling Standard
 2. ANSI/TIA-568-D Optical Fiber Cabling Components Standard (2016)
 3. ANSI/TIA/EIA-606-B-2016 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

1.3 DEFINITIONS

- A. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.
1. ADA Americans With Disabilities Act.

2. AFC Above Finished Ceiling.
3. AFF Above the Finished Floor.
4. BLDG Building
5. CAT Category
6. CL Centerline
7. DIV Division
8. (E) Existing
9. FBO Furnished By District
10. HR Home Run
11. ID Inside Diameter
12. LAN Local Area Network
13. MAX Maximum
14. NIC Not In Contract.
15. OD Outside Diameter
16. OFE District Furnished Equipment.
17. PSRH Project Standard Receptacle Height.
18. PSSH Project Standard Switch Height.
19. TYP Typical
20. UON Unless Otherwise Noted.

B. Reference to Named Products

1. Selected Item: Item so noted was selected based on comparative testing of similar products. Procedure for determination of equivalence is noted in the specification for the item(s).
2. System Design Basis: Item so noted interacts with other system items to produce total system function. Substitution of this item may require coordinated substitution of other system items.
3. Design Basis: Item so noted was used as basis for system drawings to establish features, size, etc. Use of specified equivalents may require adjustment of physical layout or wiring, but does not affect system function. No preference is implied.

1.4 SUBMITTALS

A. Submit the following according to Conditions of the Construction Contract and Division 1 Specification Sections.

B. General Requirements

1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.
2. Submit in PDF format.
3. Make each specified submittal as a coordinated package complete with all information

specified herein. Incomplete or uncoordinated submittals will be returned with no review action.

4. Progress Schedule: Comply with Division 1.

C. Contractor and Key Personnel Experience.

1. A minimum of 30 days prior to installation, submit documentation of the experience of the low voltage systems, equipment and infrastructure contractor(s) and of their key personnel.
2. Qualifications shall be provided for:
 - a. the low voltage systems, equipment and infrastructure contractor(s),
 - b. the low voltage systems, equipment and infrastructure installer(s),
 - c. and the supervisor(s) (if different from the installers),
 - d. the low voltage systems, equipment, and infrastructure project engineer,
 - e. custom control system programmer.
3. A copy of the Contractor's C-7 license or C-10 licenses - both if Contractor has both.
4. A copy of testing personnel certification(s) that demonstrate that the proposed personnel have the necessary training and certifications to conform with the proof of performance testing requirements of this Division and that they are properly trained in the use of the testing equipment that will be employed by the contractor.
5. Copies of Contractor's Structured Cabling System (SCS) manufacturer's authorized vendor/installer Certification document(s).
6. Refer to Quality Assurance paragraph in this section for complete requirements.

D. Manufacturer's Product Data:

1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:
2. Data sheet for each item in each Communications Section, including all accessories, clearly marked for proposed product.
3. Material Safety Data Sheet, where applies.
4. List of Materials Schedule. For each item, include:
 - a. Referencing Specification Section
 - b. Referencing Paragraph
 - c. Referencing Drawing, if specified only on plans
 - d. Manufacturer.
 - e. Model number.
 - f. Listing, including name of Nationally Recognized Testing Laboratory.
 - g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted, per the example schedule below:

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	UL/ETL/C LA Listed
27 05 00	2.03C		XYZ	123	Y
27 15 00	2.07A1		AAA	34-56	Y
		T0.1	ZZY	456	Y

E. Field (Installation) Drawings:

1. General

- a. Drawings shall present the proposed installation using the makes and models of devices proposed for use this project; replace vendor neutral nomenclature used in bid set with the actual part numbers to be installed or provide a lookup table in the drawings to permit determining the actual part number.
- b. Where the existing systems and/or infrastructure are used and integrated into the work of the project, indicate them on drawings, including points of interface and demarcation of existing and new work.
- c. Collate, in sequence, at least the following minimum drawings, for each infrastructure and system to be installed under the work of this contract:

2. Drawing index/symbol sheet.

3. Site plans, floor plans and reflected ceiling plans.

- a. General

- 1) The identifier for each termination and cable shall appear on the drawings, either directly on the floor plans, through an associated schedule or a unique identifier associated with a fully annotated single line diagram.
- 2) Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
- 3) At scale of Contract Documents, show:
- 4) Device locations and type
- 5) Rough-in.
- 6) Mounting height.
- 7) Conduit size.
- 8) J-hook routes
- 9) Wire type.
- 10) Wire fill.
- 11) On the floor plans, indicate floor and wall mounted devices and pathway below a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.
- 12) On the reflected ceiling plan, indicate ceiling and wall mounted devices and pathway above a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.

- b. Communications Infrastructure

- 1) Provide registered communications distribution designer (RCDD) approved, drawings depicting a complete communication infrastructure in accordance with ANSI/TIA-606-B. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the communications rooms including EF, ER, CD's, BD's, and FD's to the telecommunications work area outlets.
- 2) The following drawings shall be provided as a minimum:

- 3) T1- Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.
 - 4) T-2 Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
 - 5) A complete jack numbered plan set in District standard jack numbering format in printed and AutoCAD format. Number plans with all jacks for each floor indicated on a single drawing sheet. Data, voice, wireless and security jacks shall appear on the same page. Symbols shall be indicated for the data, wall phone, wireless, inside camera, outside camera, as applies. A four digit jack numbers shall be printed by each jack symbol. Jack plan shall be approved by the District's Representative before the cabling begins. Provide PDF copies of as-built documents.
- c. Audiovisual Systems, including MATV Systems, Audiovisual Systems and Public and Mass Notification Systems
- 1) Indicate:
 - 2) Device locations, orientation and depict integration of systems that need to be viewed from the complete building perspective.
 - 3) For distributed speaker systems, indicate limits of zones of coverage.
 - 4) Vertical and horizontal pathways
 - 5) Equipment rooms and racks
 - 6) Reference to enlarged plans and related details.
4. Enlarged Plans
- a. General
- 1) Indicate at least as much information as is provided in the Contract Documents, supplemented by the dimensions and arrangement of the proposed equipment, trade coordination and field conditions.
- b. Communications Infrastructure.
- 1) Communications Rooms Drawings
 - 2) Provide T3 drawings in accordance with ANSI/TIA-606-B that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Include rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.
 - 3) At scale of Contract Documents, the Contractor shall submit scaled drawing elevations (showing dimensions, mounting locations and associated frames & equipment) for all required assemblies, including but not limited to:
 - 4) Rack locations
 - 5) Wall mounted plywood backboards
 - 6) Wall mounted backbone cabling and major station cable bundles.
 - 7) Wall mounted and tray mounted splice cases
 - 8) Wall mounted copper cable protectors and terminal blocks.
 - 9) Wall mounted fiber optic cable terminations.

- 10) Clearances
 - 11) Backboard Wire and Cable Management
 - 12) Rack elevations, including
 - 13) Copper cable patch panels.
 - 14) Fiber optic cable patch panels.
 - 15) Rack mounted wire managers
 - 16) Hold clears for equipment provided by Others.
 - 17) Reference to mounting details.
 - 18) Power strips
 - 19) UPS
 - 20) Drawings may also be an enlargement of a congested area of T1 or T2 drawings.
- c. Audiovisual Systems, including MATV Systems, Audiovisual Systems and Public and Mass Notification Systems
- 1) At equipment rooms
 - 2) Rack elevations, showing
 - 3) all equipment occupying the actual number of rack units required
 - 4) blank panels
 - 5) vent panels
 - 6) aux panels
 - 7) power strips
 - 8) UPS
 - 9) Reference mounting details.
5. System Conduit and Riser Diagrams,
- a. General:
- 1) Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
 - 2) Single line diagram of structured wiring
 - 3) Grounding and bonding scheme
 - 4) Terminal cabinets.
 - 5) Coordination with floor plans.
 - 6) Wire runs not shown on floor plans.
 - 7) Wire type.
 - 8) Wire fill.
 - 9) Interface to work provided by work of other Sections, District Furnished Equipment, existing equipment and/or future equipment.
 - 10) For Audiovisual Systems, indicate digital or analog signal type and voltage levels (dBmV, microphone, line level, speaker level) or optical signal levels.
6. Detail Drawings
- a. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
- b. Supports for such items shall be provided support, bracing, and anchorage, designed by the Contractor in accordance with the following criteria:
- 1) Design to resist seismic forces in accordance with CBC Chapter 16.
 - 2) Minimum Design Parameters - As defined for the Project in Division, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, Spectral Acceleration and SDI.
- c. Mounting details:

- 1) Specific details of restraints including anchor bolts submitted under the Section 27 05 29 – Hangers and Supports for Communications Systems for mounting and maximum loading at each location, showing compliance and coordination with Code and the project Architectural, Structural and Mechanical Documents.
 - 2) Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.
 - 3) Submit an accompanying Engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.
 - 4) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.
 - 5) Show loads, type and strength of connections, sizes, dimensions, materials, etc.
 - 6) Provide details for:
 - 7) Floor Mounted Equipment Cabinet and Rack anchorage.
 - 8) Wall Mounted Racks and Enclosures anchorage, including coordination with backing.
 - 9) Cable Runway and Cable Tray. Indicate tray type, dimensions, support points, and finishes.
- d. For systems with contractor or manufacturer programmed control and human interfaces the Contractor must allow sufficient time for the programming of all software configurable audio, video and control systems. Contractors must evaluate the systems functional requirements and user interface and then allow time in their bid accordingly. The system description as well as an end user interview will provide the Contractor with the necessary information needed to proceed with the programming. Any questions as to the systems functional requirements must be sent in written RFI form to the District. All programming schemes must be submitted to the District for approval before programming starts. This includes the appearance of all user interfaces, touch panel layouts, preset and sub-preset information (acquired through client interviews), and speaker control schemes. The Contractor will also submit a narrative for the control system concept to the District for approval. The Contractor is to interview the District and their representatives to acquire the necessary information needed to allow for the proper programming of this system. The Contractor, after interviewing the District, will then submit a written report stating his interpretation of the client's requirements for approval by District. Only after the Client and District have approved the programming report may the Contractor proceed with the programming of this system. Submit at least:
- 1) Narrative of the sequence of operation.
 - 2) Color, full-size layouts of each touchpanel and/or computer screen (menu) image, cross-referenced to the sequence of operations.
 - 3) Show chaining of sub-menus.
- e. Faceplate and Receptacles
- 1) Receptacle and jack arrangement for each condition.
 - 2) Labeling of receptacle/jacks and plate
 - 3) Plate material.
 - 4) Plate finish.
 - 5) Connector types.
 - 6) Connector dimensioned layout.
- f. Pathway

- 1) Cable tray installation details, indicating complete system of fittings and radsussed pathways provided.
- 2) Firestopping. Listed fire stop system documentation supporting proposed systems ability to conform with the project requirements.
- 3) Penetrations. All conduit and piping wall, ceiling, floor, and roof penetrations, including both fire rated or non-rated, should be submitted for review prior to installation.
- 4) For cored penetrations through concrete partitions, submit proposed work plan in the form of Coring/Sawcutting Summary Description as described in Section 27 05 33 – Conduits and Backboxes for Communications Systems.
- 5) Details of flexible raceway connections to be made to vibrating equipment
- 6) Details of J-Box and sealant application for the typical conditions listed in Section 27 05 48 – Noise and Vibration Controls for Communications System, and a schedule of rooms to receive application of mastic and sealant at J-Boxes
- 7) An itemized list of all items of equipment to be fitted with flexible electrical connections.
- 8) Conduit racking details.
- g. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.
- h. Terminal cabinets: Terminations.

F. Cabling and Equipment Test Plan

1. Submit complete documentation of the proposed test plan and equipment to be used to document that the performance of the cabling, equipment, sub-systems and complete systems installed under the work of this project conform with the performance standards outlined in each specification section.
2. Submit not less than 45 days prior to the proposed test date. Include procedures for certification, validation, and testing.
3. Submit manufacturer's or recognized national test laboratory's calibration certificate one (1) month before any post-installation testing begins. Date on test unit calibration certificate shall be no longer than one (1) year prior to the date that post-installation testing is scheduled to begin.
4. Submit a copy of the Test Equipment manufacturer's recommended testing procedure for each of the structured cabling system elements listed above in this section.

G. Test Reports

1. Manufacturer's Field Reports
 - a. Factory reel tests
2. Project Site Test Reports:
 - a. Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.
 - b. Schedule: Submit test reports in timely manner relative to Project schedule such that the District's Representative may conduct verification of submitted test data without delay of scheduled progress.
 - c. Provide test reports as specified within each section of Division 27 requiring performance testing.
 - d. Content: Include at least:

- 1) Time and date of test.
 - 2) Personnel conducting test.
 - 3) Test equipment, including serial and date of calibration.
 - 4) Test object.
 - 5) Procedure used.
 - 6) Results of test
 - 7) Numerical or graphical presentation.
- e. Submit copy of final results on paper and in electronic form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.
- 1) Submit machine-generated documentation and raw data of all test results in electronic form on CD-R media
 - 2) Where the electronic documentation requires use of a proprietary computer program to view the data, provide the District's Representative with 1 licensed copy of the software.
- H. Hazardous Materials Notification: In the event no product or material is available that does not contain asbestos, PCB or other hazardous materials as determined by the District's Representative, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
- I. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB), using format in Article 3 of General Conditions using format in Division 1 Section "Closeout Procedures".

1.5 QUALITY ASSURANCE

- A. Procedures: In accordance with Section 01 40 00 – Quality Requirements.
- B. Qualifications
1. Telecommunications Qualifications
 - a. Work under this section shall be performed by and the equipment shall be provided by the telecommunications contractor and key personnel.
Qualifications shall be provided for:
 - 1) the telecommunications system contractor,
 - 2) the telecommunications system installer,
 - 3) and the supervisor (if different from the installer),
 - 4) the project engineer,
 - 5) the custom control system programmer.
 - b. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.
 2. Telecommunications Contractor
 - a. The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment.
 - 1) The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
 - 2) Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.
 - b. Key Personnel

- 1) Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
 - 2) Designated Supervisor: Provide a designated Project Manager--can be separate from or the same individual as the Lead Technician mentioned in 1.5-B-5-b-3, in responsible charge of the fabrication shop and on the Project Site during all phases of installation and testing of the work of this specification. The Project Manager shall hold current Avixa (previously Infocomm) CTS-D, CTS-I or CTS and Extron AV Associate certifications and shall be the same individual through the execution of the work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
 - 3) Project Engineer: Provide a designated Project Engineer in responsible charge of the Design, CAD, In-House testing and on the on-site commissioning of the Project during all phases of the work of this specification. This Project Engineer shall hold a current Avixa (previously Infocomm) CTS- D, Extron XTP/DTP and Extron AV Associate certifications and shall be the same individual through the execution of the work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
 - 4) All Technicians shall have at least two (2) years direct experience in similar work. The AV technicians assigned to this project shall be fully trained, qualified and carry valid and current industry certifications regarding the, installation, operation and testing of audiovisual systems. At least one Avixa (previously Infocomm) CTS-I or CTS and Extron XTP for Technicians shall be assigned as Lead Technician to the project.
 - 5) Custom Control System Programmer: Provide at least one (1) full time programmer on staff, capable of on-site custom programming of the custom remote control system specified herein. Control System Programmer to hold the following certifications: Avixa (previously Infocomm) CTS-D, CTS-I or CTS along with Extron Control Professional, Extron ProDSP Specialist certifications and 3 years of direct experience.
 - 6) Note that only the key personnel approved by the District's Representative in the successful proposal shall perform work on this project's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from the District's Representative.
3. Minimum Manufacturer Warranty (For Commscope Systimax – District Standard)
- a. The District requires the contractor to be trained and certified to provide the following minimum manufacturer's warranty:

- 1) Structured Connectivity Solutions 25-Year Extended Product Warranty. A 25 Year extended product warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568B and ISO/IEC IS 11801, and provide an end-to-end solution in accordance with the application standards. The warranty shall apply to all passive cabling components. The 25 Year extended product warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a twenty five (25) year period.
 - 2) Structured Connectivity Solutions 25-Year Extended Application Assurance. A 25 Year application assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future, by recognized standards or user forums that use the TIA/EIA 568B or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty (25) year period.
 - 3) In the event that the District sells a building that has been warrantied, the warranties shall be transferable to the new District.
4. Audiovisual Qualifications
- a. Audiovisual Systems work shall be performed by and the equipment shall be provided by the Audiovisual Systems contractor and key personnel. Qualifications shall be provided for:
 - 1) the Audiovisual Systems contractor,
 - 2) the Audiovisual Systems installer,
 - 3) and the supervisor (if different from the installer).
 - b. A minimum of 30 days prior to installation, submit documentation of the experience of the Audiovisual Systems and of the key personnel.
5. Audiovisual Systems Installer
- a. The installer of the audiovisual systems shall be a firm regularly and professionally engaged in the business of installation, configuration and testing of the specified audiovisual systems and equipment.
 - 1) Where the manufacturers of the specified and contractor proposed systems provide mandatory installer and programming training programs, the Contractor's programming and installation staff shall provide documentation to demonstrate their successful completion of the relevant training programs for the types and versions of equipment proposed for installation on this Project.
 - 2) Where the manufacturer of the specified and contractor proposed systems and equipment lawfully restricts sales of their equipment to a network of dealers, the contractor shall provide documentation to their standing as such a dealer in good standing at the time of bid submittal.
 - 3) The audiovisual systems contractor shall demonstrate experience in providing successful audiovisual systems of a similar scope and nature of those required by the work of this Project within the past 3 years.
 - 4) Submit documentation for a minimum of three and a maximum of five successful audiovisual system installations for the audiovisual systems contractor.
 - b. Key Personnel
 - 1) Provide key personnel who are regularly and professionally engaged in the business of the installing, programming, configuring and testing of the specified audiovisual systems and related presentations and equipment.

- a) There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided.
 - b) Each of the key personnel shall demonstrate experience in providing successful audiovisual systems of a similar nature scope and extent to those required by the work of this Project within the past 3 years.
- C. Test Plan
1. Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 45 days prior to the proposed test date. Include procedures for certification, validation, and testing.
- D. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
- E. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.
1. A complete set of the latest stamped, actioned submittals of record.
 2. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.
- F. Test Equipment
1. Requirements:
 - a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.
 - b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until District Acceptance of this Work; thereafter remove all of this test equipment from the job site.
 - c. Unless otherwise indicated, test equipment shall remain property of the Contractor.
 - d. Provide all required test cables, jigs and adapters.
 - e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.
 2. Equipment: Specified in individual Sections.

1.6 REGULATORY REQUIREMENTS

- A. Regulations Applicable: Including but not limited to those defined in Section 01 11 00 – Summary of Work.
1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
 2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.

3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the District's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 DELIVERY, STORAGE AND HANDLING

A. Procedures:

1. In accordance with Section 01 60 00 – Product Requirements and as specified in the individual sections of Division 27.

B. General

1. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

1.9 SEQUENCING

- A. Comply with Section 01 11 00 - Summary of Work, 01 30 00 – Administrative Requirements, and the following.

1. Reproducibles:

- a. 1 set of reproducible bond.
- b. CAD files: 1 set.
- c. Provide PDF copies.

1.10 OPERATING AND MAINTENANCE DATA

- A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system.

1. Submit operations and maintenance data in accordance with Section 01 70 00 – Execution and Closeout Requirements and as specified herein not later than 2 months prior to the date of beneficial occupancy.

1.11 PROJECT RECORD DOCUMENTS

- A. Comply with Section 01 70 00 – Execution and Closeout Requirements, and the following.

1. Record Drawings

a. CAD.

- 1) Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid. (Campus Standard, no substitution permitted).

- b. Except where prohibited by Contract, District's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, latest version at time of bid, for use by the Contractor in preparing Record Drawings.
 - c. Provide PDF copies.warranty
2. Provide drawings including documentation on cables and termination hardware in accordance with ANSI/TIA/EIA-606-A. The drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. Provide the following drawing documentation as a minimum:
- a. Cables - A record of installed cable shall be provided in accordance with ANSI/EIA/TIA-606-A. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with ANSI/TIA/EIA-606-A. Include manufacture date of cable with submittal.
 - b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with EIA TIA/EIA-606-A. Documentation shall include the required data fields as a minimum in accordance with EIA TIA/EIA-606-A.
3. Spare Parts
- a. In addition to the requirements of Section 01 70 00 – Execution and Closeout Requirements, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.
4. For each IDF, the contractor shall provide (1) printed copy of the outlet numbering plan for the IDF-serving area. The plan shall be printed on D-size, dated, with contractor contact information, and a framed for hanging on the IDF wall.

1.12 WARRANTY SERVICE

- A. In addition to provisions of 01 70 00 – Execution and Closeout Requirements, provide the following.
 1. Response Time: Provide a qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of malfunction. Provide the District's Representative with telephone number attended 8 hours a day, 5 days a week, to be called in the event of a malfunction.
- B. Provide all additional Warranties as defined in each Communication Systems Section.

1.13 ACCEPTANCE REVIEW AND TESTING PROCEDURES

- A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the District's Representative in writing that the Work of these Sections is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing. The District's Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These procedures may be performed at any hour of the day or night as required by the District's Representative to comply with the Project Schedule and avoid conflict with Residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.

- B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.
- C. In Addition, Provide:
 - 1. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
 - 2. Ladders, scaffolding and/or lifts as required to access high devices.
 - 3. All test equipment.
 - 4. Complete set of latest stamped, actioned submittals of record for reference.
 - 5. Complete set of Test Reports.
 - 6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
 - 7. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.
 - 8. Adjust: As directed by the District's Representative.
 - 9. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the District's Representative.
- D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the District's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

1.14 CLOSEOUT

- A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the District's Representative of completion of Punch List.
- B. Portable Equipment: Furnish all portable equipment and spares to the District's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.
- C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.
- D. Project Record Documents: Submit print and digital copies. Digital files shall be in CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid.
- E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the District's Representative.
- F. Instruction: Conduct specified instruction.
- G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

PART 2 PRODUCTS

2.1 GENERAL

- A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
- B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.
- C. Products shall be made by manufacturers regularly engaged in the production of such products.
- D. Provide quantity as shown on Contract Drawings, or as otherwise indicated.
- E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.
- F. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.
- G. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.
- H. Components
 - 1. UL or third party certified. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.
 - 2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.
 - a. The label or listing by the specified organization will be acceptable evidence of compliance.
 - b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the District's Representative.
 - c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
 - 3. Products shall provide a complete end-to-end system of connectivity and shall be warranted as a system by the manufacturer.
- I. Enclosures:
 - 1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.
 - 2. Make bolted connections with self-locking devices.
- J. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.
 - 1. Finishes noted or scheduled on the Contract Drawings take precedence.
 - 2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.

3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the District's Representative.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

3.2 PREPARATION

- A. Prepare and sequence the work to minimize disruption to each room environment and existing communications systems.
- B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.3 REPAIR AND RESTORATION

- A. Where working in spaces occupied by the District, return to their original positions any furniture or articles relocated to perform the work.

3.4 CLEANING

- A. Where working in spaces occupied by the District:
 1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.
 2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Section 01 70 00 – Execution and Closeout Requirements for additional requirements.
 3. All dust resulting from work performed shall be vacuumed up daily.
 4. All scrap material shall be removed from site and disposed of in an authorized disposal site. Refer to Section 01 74 19 – Construction Waste Management and Disposal.

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SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Section includes grounding and bonding of Communications Work, including but not limited to:

1. Communications Raceways
2. Cable Runway
3. Cable Shields
4. Protector Fields
5. Communications cabinets and enclosures.

B. Related Work Under Other Sections

1. Related Sections:
 - a. Section 27 0500 – Common Work Results for Communications
 - b. Section 27 0529 – Hangers and Supports for Communications Systems
 - c. Section 27 0533 – Conduits and Backboxes for Communications Systems
 - d. Section 27 0536 – Cable Trays for Communications Systems
 - e. Section 27 1000 – Structured Cabling, Basic Materials and Methods
 - f. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
 - g. Section 27 1119 – Communications Termination Blocks and Patch Panels
 - h. Section 27 1123 – Communications Cable Management
 - i. Section 27 1126 – Communications Rack Mounted Power Protection & Power Strips
 - j. Section 27 1300 – Communications Interior Backbone Cabling
 - k. Section 27 1500 – Communications Horizontal Cabling

1.2 SYSTEM DESCRIPTION

A. Provide telecommunications system grounding conductor as described herein and indicate on drawings.

B. Except as otherwise indicated, the complete communications installation including the metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.

C. Resistance:

1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-A-2002, whichever is more restrictive.

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-606-B-2016 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
2. ANSI/TIA-607-D-2019 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
3. Underwriters Laboratories (UL)
4. UL 467 (1993); R 2004 Grounding and Bonding Equipment

1.4 SUBMITTALS

- #### A. Conform with the requirements of Section 01 30 00 – Administrative Requirements and Section 27 05 00 Common Work Results for Communications.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- #### A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Ground Rod:

- a. High strength high carbon steel, with electrolytically bonded jacket of copper on surface
- b. UL spec. 467
- c. ANSI C-33.8-1072.
- d. Manufacturer:
 - 1) Allied Bolt
 - 2) Inwesco 12A60
 - 3) Blackburn
 - 4) Cooper Power Systems
 - 5) Weaver.
 - 6) Erico "Cadweld" Products, Inc.
 - 7) ITT Blackburn.
 - 8) Or equal.

2. Ground Wells:

- a. Christy Concrete Products, Inc.
- b. Forni Corp.
- c. Or equal.

3. Ground Bushings, Connectors, Jumpers and Bus:

- a. O-Z/Gedney.
- b. Thomas & Betts Corp.
- c. Or equal.

4. Compression Connector Lug

- a. Panduit
 - b. B-Line SB-479 Series
 - c. Thomas & Betts
 - d. Or equal.
5. Telecommunications Ground Bus Bar
- a. CPI
 - b. B-Line
 - c. Panduit
 - d. or equal.
6. Bonding Ribbon:
- a. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.
 - b. Manufacturer:
 - 1) Inwesco 12A55
 - 2) Corning Cable Systems
 - 3) Preformed Line Products.
 - 4) or equal.
7. Bonding Ribbon Clamp:
- a. Soft lead
 - b. 1/16 inch thick
 - c. Bolt hole for attachment
 - d. Manufacturer:
 - 1) Inwesco 12A56
 - 2) Corning Cable Systems
 - 3) Preformed Line Products.
 - 4) Or equal.
8. Fargo Clamp:
- a. Cast copper, silver plated, furnished with copper bolt.
 - b. RUS Listed
 - c. Manufacturer:
 - 1) Allied Bolt
 - 2) Inwesco 12A57
 - 3) Corning Cable Systems
 - 4) or equal.
9. Ground Inserts:
- a. Cast Bronze w 1/4 Copper Rod.
 - b. Provide minimum one each maintenance hole or vault.
 - c. Manufacturer:

- 1) Inwesco 12H69
- 2) or equal by vault or manhole manufacturer.
- 3) or equal.

2.2 GROUND CONDUCTORS

- A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with NEC..
- B. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

2.3 COMPRESSION CONNECTOR LUG

- A. Description
 1. Connector lug with compression connection to conductor.
 2. Copper alloy body.
 3. Provide lug size to match conductor being terminated.
 4. Provide 2 hole pattern lugs.
 5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.

2.4 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.5 CONNECTIONS TO PIPE

- A. For cable to pipe: UL listed bolted connection complying with CEC requirements.

2.6 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

- A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
- B. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
- C. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.

2.7 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

- A. Where required by the drawing or specified herein.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide Grounding and Bonding according to the most restrictive requirements of:
 - 1. California Electrical Code Article 250 and references therein.
 - 2. California Electrical Code Article 800.
- B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.
- C. Point of Connection
 - 1. Under Work of this Section, make connections to Communications Ground Busbars provided under Work of Section 26 0526 Grounding.
 - 2. Mechanical Connections
- D. Make connections bare metal to bare metal.
 - 1. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.
 - 2. Torque threaded fasteners to manufacturer's recommended values.
- E. Compression Connections
 - 1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.
- F. Communications Raceways and Sleeves
 - 1. Bond metallic raceway and sleeves to the Communications Ground Busbar at the Communications Room that serves the related Communications Receptacle.
 - 2. Where a metallic raceway connects 2 or more Communications Rooms, bond to the Communications Ground Busbar at each.
- G. Cable Tray and Cable Runway
 - 1. Coordinate with the Work of Section 27 0533 - Conduits and Backboxes for Communications Systems.
 - 2. Provide manufacturer's bonding clips, plates or jumpers as required to comply with the UL Classified conditions for use as an equipment grounding conductor.
 - 3. Bond the Cable Runway to the Communications Ground Busbar at the Communications Room served.
- H. Cable Shields
 - 1. Comply with California Electrical Code Article 800.
- I. Protector Fields
 - 1. Comply with California Electrical Code Article 800.
- J. Communications cabinets and enclosures
 - 1. Bond to the Communications Ground Busbar at the Communications Room.
- K. Emergency/Information Telephone enclosures
 - 1. Bond as detailed on Communications Drawings.

L. Communications Broadband Systems

1. Comply with California Electrical Code Article 820.
2. Ground Broadband passives as shown on Communications Drawings.

3.2 LABELING

A. Provide labeling according to the requirements of:

1. ANSI/TIA/EIA-606-A.
2. Section 27 0553 Identification for Communications Systems.

END OF SECTION

SECTION 27 0529

HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of communications supports and cable hook system as described in this specification, including but not limited to:
1. Strut supports
 2. Cable Hooks (J-hooks)
 3. Beam clamps
 4. Concrete Fasteners
 5. Touch-Up Materials
 6. Conduit supports.
 7. Equipment supports.
 8. Fastening hardware.
- B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
1. Section 03 3000 – Cast-in-place Concrete. Concrete equipment pads.
 2. Section 27 0500 – Common Work Results for Communications
 3. Section 27 0526 – Grounding and Bonding for Communications Systems
 4. Section 27 0533 – Conduits and Backboxes for Communications Systems
 5. Section 27 0536 – Cable Trays for Communications Systems
 6. Section 27 0548 – Noise and Vibration Controls for Communications Systems
 7. Section 27 0553 – Identification for Communications Systems
 8. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
 9. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
 10. Section 27 1123 – Communications Cable Management
 11. Section 27 1300 – Communications Interior Backbone Cabling
 12. Section 27 1500 – Communications Horizontal Cabling

1.2 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of communications equipment specified for this Project.
- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.3 REFERENCES

- A. American Society For Testing and Materials (ASTM)
 - 1. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 3. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
 - 4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. American National Standards Institute (ANSI)
 - 1. ANSI/TIA/EIA-568-C.1-2009 Commercial Building Telecommunications Cabling Standard
 - 2. ANSI/TIA-568-D Optical Fiber Cabling Components Standard (2016)
 - 3. ANSI/TIA-569-C-2012 Telecommunications Pathways and Spaces
- C. National Fire Protection Association
 - 1. NFPA 70, National Electrical Code

1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 - Common Work Results for Communications.

1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Cable hooks shall be listed and labeled by Underwriters Laboratories (UL) as required.
- C. Cable hooks shall have the manufacturers name and part number stamped in the part itself for identification.

PART 2 PRODUCTS

2.1 SUPPORTING DEVICES

- A. General
 - 1. Supports to be sized to suit load and selected to match mounting conditions
- B. Manufacturers
 - 1. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - a. Concrete fasteners:
 - 1) Phillips "Red-Head".
 - 2) Remington.
 - 3) Ramset.
 - 4) Hilti

- 5) Simpson Strong-Tie
 - 6) or equal.
 - b. Concrete inserts and construction channel:
 - 1) Unistrut Corp.
 - 2) GS Metals "Globe Strut."
 - 3) Thomas & Betts "Kindorf" Corp.
 - 4) Or equal.
 - c. Conduit straps:
 - 1) O-Z/Gedney.
 - 2) Erico "Caddy" Fastening Products.
 - 3) Thomas & Betts "Kindorf" Corp.
 - 4) Or equal.
 - d. Beam Clamps
 - 1) Cooper B-Line
 - 2) SuperStrut
 - 3) Unistrut
 - 4) or equal
 - e. Aircraft Cable Sway Braces
 - 1) Mason Industries
 - 2) M.W. Sausse/Vibrex
 - 3) Loos & Company, Inc.
 - 4) or equal.
- C. Concrete Fasteners
1. Provide expansion-shield type concrete anchors.
 2. Provide powder driven concrete fasteners with washers. Obtain approval by Owner's Representative prior to use.
- D. Concrete Inserts
1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.
- E. Aircraft cable sway braces
1. Steel rope sized to meet load.
- F. Construction Channel:
1. Construction:
 - a. 1-5/8" square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.
 - b. 10 foot sections.
 2. All supporting materials by same manufacturer.

G. Beam Clamps

1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.

H. Conduit Straps

1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
 - a. Use malleable strap with spacers for exterior and wet locations.
 - b. Use steel strap without spacers for interior locations.
2. Steel channel conduit strap for support from construction channel.
3. Steel conduit hanger for pendant support with threaded rod
4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

I. Threaded rods, couplings, screws and nuts:

1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

J. Miscellaneous Parts

1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.

K. Paint/Tape for Touch-up:

1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing "Galambra", or equal.

2.2 CABLE HANGERS

A. Ceiling Hung J-Hooks

1. Drawing Reference(s):
 - a. WMJ
 - b. ACJ
2. Features/Functions/Construction
 - a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
 - b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.
 - c. Integral hanger rod attachment hardware at top.
 - d. Load rated for application.
 - e. Incorporates smooth 90-degree radiused edges to prevent snagging cable jackets on installation.
 - f. Designed so the mounting hardware is recessed to prevent cable damage.
 - g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
 - h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
 - i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.

- j. Finishes:
 - 1) Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
 - 2) Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
- 3. Manufacturer
 - a. Cooper B-Line series BCH21, BCH32, BCH64, BCH-HBA.
 - b. Caddy/Erigo CableCat
 - c. or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. The Owner's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.2 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.3 PREPARATION

- A. Coordinate size, shape and location of concrete pads required for equipment installation with Base Building General Contractor.
- B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where shown on the Drawings or Specifications, install freestanding communications equipment on concrete pads.

3.4 INSTALLATION

- A. Furnish and install supporting devices as noted throughout the Communications Systems work.
- B. Communications device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
- E. Use expansion anchors or preset inserts in solid masonry walls.
- F. Use self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.
- G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.

- H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
 - I. Do not drill structural steel members unless first approved in writing by the Owner's Representative.
 - J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
 - K. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
 - L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.
- 3.5 ERECTION OF METAL SUPPORTS
- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
 - B. Field Welding: Comply with AWS "Structural Welding Code."
- 3.6 WOOD SUPPORTS
- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- 3.7 ANCHORAGE
- A. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division weighing more than 20 pounds, inclusive of mounting systems, and for equipment mounted at the exterior, inclusive of its effective wind load under the range of conditions experience.
 - a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing seismic forces in conformance with CBC Sections 1613A and 1614A.
 - b. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.
- 3.8 DISTRIBUTION PATHWAY VIA CEILING HUNG CABLE HOOKS (J-HOOKS):
- A. Void, Plenum or Suspended Ceiling Exposed Cable Installation. Where drawings specifically show or permit use of exposed cable installation in voids, conform to the most restrictive requirements of Code, TIA-569-B and this Section.
 - B. Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures or building structure. Conform to the California Electric Code.
 - C. Placement:
 - 1. All pathways created by ceiling hung cable hooks shall be reviewed by the Owner's Representative prior to installation.

2. Ceiling hung cable hooks and cabling supported by same shall not obscure access to access doors, hatches, air dampers, valves, filter sections, VAV boxes, cable trays, junction boxes, pull boxes or similar areas of access required by other trades.
3. All ceiling hung cable hooks shall be mounted close enough together such that upon completion of the station cable installation a minimum amount of cable droop occurs between adjacent rings. The distance between supporting rings shall not exceed 48 inches or as required by the current edition of TIA-569-B.
4. Refer to the separation requirements listed in Section 27 15 00 – Communications Horizontal Cabling for minimum distances from electrical power and other electro-magnetic sources.
5. All cable hook pathways shall be dedicated for use by voice/data cabling. Any cables required for other low voltage systems shall be routed with a separate suspension system.

END OF SECTION

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SECTION 27 0533

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK:

- A. Provide telecommunications pathways in accordance with EIA TIA/EIA-569-B, as specified in this Section and as shown on the plans. Provide system furniture pathways in accordance with UL 1286. Provision of all low voltage Communications Systems Pathway and Electronic Security and Safety System Pathway, including:
 - 1. Rigid steel conduit and fittings.
 - 2. PVC insulated rigid steel conduit and fittings.
 - 3. Intermediate metal conduit and fittings.
 - 4. Electrical metallic tubing and fittings.
 - 5. Flexible metallic conduit and fittings.
 - 6. Liquidtight flexible metallic conduit and fittings.
 - 7. Miscellaneous conduit fittings and products.
 - 8. Junction Boxes
 - 9. Floor Boxes
 - 10. Hinged cover enclosures.
 - 11. Pullboxes and Terminal Cabinets.
- B. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.
- C. All conduits and suspension system for conduits for communications cabling shall be dedicated for voice/data cable routing, and shall not be shared with any other cabling system.

1.2 RELATED WORK IN OTHER SECTIONS:

- A. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Section 01 7329 – Cutting and Patching.
 - 2. Section 27 0500 – Common Work Results for Communications.
 - 3. Section 27 0526 – Grounding and Bonding for Communications Systems
 - 4. Section 27 0529 – Hangers and Supports for Communications Systems
 - 5. Section 27 0536 – Cable Trays for Communications Systems
 - 6. Section 27 0548 – Noise and Vibration Controls for Communications Systems
 - 7. Section 27 1000 – Structured Cabling, Basic Materials and Methods
 - 8. Section 27 1300 – Communications Interior Backbone Cabling
 - 9. Section 27 1500 – Communications Horizontal Cabling

1.3 REFERENCES

- A. Usage: In accordance with Section 01 11 00 – Summary of Work.
1. American National Standards Institute (ANSI)
 - a. ANSI C80.1 1994 Rigid Steel Conduit - Zinc Coated
 - b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated
 2. National Electrical Manufacturers Association (NEMA)
 - a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
 - d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
 - e. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
 - f. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
 - g. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - h. NEMA TC 72000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
 - i. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
 - j. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
 3. Underwriters Laboratories, Inc. (UL)
 - a. UL 1 2000 Flexible Metal Conduit
 - b. UL 6 2004 Electrical Rigid Metal Conduit - Steel
 - c. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
 - d. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
 - e. UL 514A 1991 (R 2004) Metallic Outlet Boxes
 - f. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings
 - g. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - h. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.
 - i. UL 797 1993 (R 2004) Electrical Metallic Tubing - Steel
 - j. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.
 - k. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings
 - l. UL 1479 Fire Tests of Through Penetration Firestops
 - m. UL Fire Resistance Directories

1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 - Common Work Results for Communications.

1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the Owner's Representative.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide the following types of conduit systems listed by their commonly used generic name.

2.2 RACEWAY

A. Manufacturers:

- 1. Raceway:
 - a. Allied Tube and Conduit Co.
 - b. Triangle PWC, Inc.
 - c. Western Tube and Conduit Corp.
 - d. Spring City Electrical Manufacturing Co.
 - e. Occidental Coating Co. (OCAL).
 - f. Alflex Corp.
 - g. American Flexible Metal Conduit Co.
 - h. Anaconda.
 - i. Or equal.
- 2. Fittings:
 - a. Appleton Electric Co.
 - b. OZ/Gedney.
 - c. Thomas & Betts Corp.
 - d. Spring City Electrical Manufacturing Co.
 - e. Occidental Coating Co. (OCAL).
 - f. Carlon.
 - g. or equal.

B. Rigid Steel Conduit.

- 1. Drawing and Spec Reference: RSC.
- 2. Construction:
 - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
 - c. Three piece couplings: Electroplated, cast malleable iron.
 - d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.

- e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
 - f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.
 - g. All fittings and connectors shall be threaded.
- C. Coated Rigid Steel Conduit:
1. Drawing and Spec Reference: CRSC.
 2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
 3. Fittings:
 - a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.
 - b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.
 4. Performance:
 - a. Tensile Strength: 3500 psi.
 5. Approvals:
 - a. NEMA RN1 (Type 40 - 40 mils thick)
 - b. CalTrans Type 2
 6. Manufacturers:
 - a. Plastibond by RobRoy Industries.
 - b. Occal-40 by Occidental Coating Company.
 - c. KorKap by Plastic Applicators.
 - d. Ocal-Blue
 - e. or equal.
- D. Intermediate Metal Conduit
1. Drawing Reference: IMC
 2. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.
 3. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.
- E. Electrical Metallic Tubing.
1. Drawing and Spec Reference: EMT.
 2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.
 3. Set screw type couplings: Electroplated, steel or cast malleable iron, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

4. Set screw type connectors: Electroplated steel or cast malleable iron UL listed concrete tight with male hub and insulated plastic throat, 150 degree C temperature rated. Setscrew shall be same as for couplings.
5. Raintight couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.
6. Raintight connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

2.3 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

A. General

1. UL 514B.
2. Listed in UL Electrical Construction Materials List.

B. Conduit Fittings, Insulated Throat Grounding Bushings

1. Description
 - a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. UL Listed for use with copper conductors.
 - c. Thermoplastic insulated liner for 105 degrees Celsius.
 - d. Body of malleable iron, zinc plated; or die cast zinc.
2. Manufacturer
 - a. Thomas & Betts (Steel City) BG-801 Series
 - b. O-Z/Gedney
 - c. or equal.

C. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

D. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

E. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.

F. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.

1. Manufacturer:
 - a. OZ/Gedney Type DX
 - b. Steel City Type EDF
 - c. or equal.

G. Fire rated penetration seals:

1. UL classified.
2. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.
3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
4. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.
5. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.

H. Standard products not herein specified:

1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.
2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

I. Hazardous area fittings: UL listed for the application.

2.4 JUNCTION AND DEVICE BOXES

A. 5" Square Junction Box

1. Drawing References: As indicated on Symbol Schedule
2. Construction
 - a. 5 in. Square x 2.875 in. Deep Metal backbox with an integral cable management system.
 - b. Use on Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits only.
 - c. During construction rough-in, telecommunications backboxes shall be marked in blue for telecom and yellow for AV to be visually distinguished purpose.
3. Manufacturer
 - a. Randl Industries, Inc. 5 Square Telecommunications Outlet Box T-55017 with D-51G000 one gang ring.
 - b. Or equal.

2.5 CABINETS AND ENCLOSURES

A. Terminal Cabinets:

1. Drawing Reference: As Scheduled.
2. Construction:
 - a. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.
 - b. Interior dimensions not less than those scheduled.
 - c. Finish: Manufacturer's standard gray baked enamel finish.

- d. Covers: Trim fitted, continuous hinged steel door, flush catch – lockable and keyed to match. Screw fastened doors not acceptable.
 - 1) Door face to be not less than 95% of panel interior dimensions.
 - e. Provide with 3/4" fire retardant treated ply backboard.
3. Mounting:
- a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
 - b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.
 - c. Interior Applications:
 - 1) NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.
 - d. Exterior Applications:
 - 1) NEMA 250 Type - As Scheduled, not less than NEMA 3R.
4. Manufacturers:
- a. B-Line Electrical Enclosures
 - b. Circle AW Products.
 - c. Hammond
 - d. Henessey.
 - e. Hoffman.
 - f. Myers Electric Products
 - g. Rittal.
 - h. or equal.

PART 3 EXECUTION

3.1 CONDUIT APPLICATION

- A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:
- 1. Exterior, Exposed:
 - a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
 - 2. Interior, Exposed, Wet and Damp Locations:
 - a. Type RSC.
 - b. At interior locations over 8 feet above finished floor, EMT acceptable.
 - 3. Interior, Hazardous Locations
 - a. Type RSC
 - b. Type IMC, where permitted by the CEC.
 - 4. Interior, exposed or concealed, dry locations:
 - a. RSC, if subject to physical abuse.
 - b. EMT, if not subject to physical abuse.
 - 5. Interior, concealed, damp locations, including in masonry walls.

- a. RSC
- 6. Embedded in Concrete
 - a. RSC or rigid non-metallic conduit.
 - b. PVC Type DB-120.
- 7. Transition from walls to open plan furniture systems:
 - a. Liquidtight

3.2 GENERAL REQUIREMENTS

- A. Refer to the manufacturer's instructions and conform thereto.
- B. Distribution Pathway via EMT Raceway:
 - 1. The EMT conduit is to be installed meeting the NEC handbook Article 348 Installation Specifications.
 - 2. Provide escutcheon plates for all through wall conduit stubs.
 - 3. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
 - 4. All conduit which passes through fire walls shall be sealed with fire stop putty after all station wire has been installed.

3.3 MOUNTING AND INSTALLATION – DEVICE BOXES

- A. Conform to the more restrictive of NEMA OS 3-2002 and the following.
- B. Provide backboxes at all communications systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.
- C. The distance between pull boxes shall not exceed 100 feet or more than two 90 degree bends.
- D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. Verify placement with Owner's Representative details to ensure that box clears all trim, etc.
- E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.
- F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.
- G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.
- H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.
- I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.
- J. Install wiring jacks and outlet devices after wiring work is complete.

3.4 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

- A. General

- 1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.
- C. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards referenced in Section 27 05 29.
- D. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.
- E. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.
- F. Terminate conduit in cabinet with lock nut and grounding bushing.
- G. Cleaning
 - 1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.
 - 2. Vacuum clean cabinet on completion of installation.

3.5 SUPPORT

- A. Provide supports for raceways as specified in Section 27 05 29 – Hangers and Supports for Communications Systems.
- B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of the this Section and Section 27 05 29 – Hangers and Supports for Communications Systems. Fasten all hangers from the building structural system.
- C. Provide supports and mounting attachments per the most restrictive of Code and the following.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
Horizontal Runs				
1≥	1-2	Flat ceiling or wall	6	6
1≥	1-2	Where access limited to building structure	10	10
1≥	3≥	Any locations	10	10
Any	Any	Concealed	10	10
Vertical Runs				
1, 1-1/4	Any	Exposed	8	8
1-1/2≥	Any	Exposed	10	10

- D. Install no more than one coupling or device between supports.
- E. Conduit support
 - 1. As specified in Section 27 05 29 – Hangers and Supports for Communications Systems
- F. The Owner’s Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the Owner.

3.6 PENETRATIONS

- A. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8" inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.
- B. Install UL listed fire-stop system whenever a raceway penetrates a firewall in conformance with the manufacturer's directions, the published systems assembly requirements, CBC Section 709 and 710 and CEC 300-21, whichever is the most restrictive. At cable tray penetrations, provide pillow type removable fire stop per CBC Section 709 and 710, the published systems assembly requirements and the manufacturer's directions, whichever is the most restrictive.
- C. All communications systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set may be core drilled.

3.7 RACEWAY INSTALLATION, GENERAL

- A. Raceway runs are shown schematically. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated.
 - 1. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.
 - 2. Raceway runs shall be mechanically and electrically continuous between all each equipment rack and utility demarcation point, receptacle and/or surface raceway strip, as applies.
 - 3. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.
 - 4. Bends
 - a. All bends or elbows shall have a minimum of 10 times the internal diameter.
 - b. Use factory elbows or machine bends for conduit bends 1-1/4" and larger.
 - 5. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.
 - 6. Install at least one (1) 3/8", 200 pound strength nylon pull cord in all empty raceways.
 - 7. Raceways crossing building expansion joints or in straight runs exceeding 100 feet shall be provided with UL listed expansion fittings.
 - 8. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Communications System enclosures.
 - 9. Conduit fill shall not exceed 40% of the conduit's cross-sectional area.
- B. Do not install conduit in concrete slabs unless specifically directed by Owner's Representative. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the Owner's Representative. Space conduits 8" on center except at cabinet locations where slab thickness shall be increased as directed by the Owner's Representative.
- C. All conduits to be kept 12" away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.

- D. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.
- E. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:
 - 1. not to be exposed to damage;
 - 2. not interfere with access to components of the equipment that will interfere with maintenance operation or;
 - 3. not to be in a manner that the Owner deems detrimental to its operation.
- F. Whenever an installation such as that listed occurs, the Contractor shall make all necessary changes at no additional cost to the Owner.
- G. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified Touch Up Paint/Tape.
- H. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the Owner's Representative.
- I. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. Prevent foreign matter from entering conduit and raceway; use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.
- J. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.
- K. Use specified conduit and raceway fittings that are of types compatible with the associated conduit and raceway and suitable for the use and location. Join and terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system and make up tight.
- L. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.
- M. Horizontal conduit or EMT runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical.
- N. Conduit and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.
- O. Conduit and EMT shall not be run through beams, purlins or columns except where permission is granted by Owner's Representative in writing.
- P. Bond installed metallic raceway in accordance with the requirements of the CEC.

END OF SECTION

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SECTION 27 0536

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Cable Trays for Communications Cabling
 - 1. Cable Trays
 - 2. Cable Runways
- B. Cable Tray Support

1.2 RELATED WORK UNDER OTHER SECTIONS

- A. Section 27 0500 – Common Work Results for Communications
- B. Section 27 0526 – Grounding and Bonding for Communications Systems
- C. Section 27 0529 – Hangers and Supports for Communications Systems
- D. Section 27 0533 – Conduits and Backboxes for Communications Systems
- E. Section 27 0548 – Noise and Vibration Control for Communications Systems
- F. Section 27 0553 – Identification for Communications Systems
- G. Section 27 1000 – Structured Cabling, Basic Materials and Methods
- H. Section 27 1300 – Communications Interior Backbone Cabling
- I. Section 27 1500 – Communications Horizontal Cabling

1.3 REFERENCES

- A. Usage: In accordance with Section 01 1100 – Summary of Work.
 - 1. National Electrical Manufacturers Association (NEMA)
 - a. NEMA FG 11-1998 Fiberglass Cable Tray Systems
 - b. NEMA VE 11-1998 Metal Cable Tray Systems.
 - c. NEMA VE 22001 Metal Cable Tray Installation Guidelines

1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 01 6000 – Product Requirements.

PART 2 PRODUCTS

2.1 Cable Tray, Cable Runway

A. Cable Runway (To be installed in BDF and IDF rooms only)

1. Drawing and spec reference: CR*, where "*" denotes nominal width of cable runway in inches.
2. Construction:
 - a. Solid Steel Side Bar per ASTM A-36 or Tubular Steel Side Bar per ASTM A-513.
 - b. 1.5" x 0.375 minimum tubular side stringers.
 - c. UL Classified splice kits.
 - d. Designed to support at least 100 pounds per foot load with a Safe Working Load deflection of ½" or less.
3. Finish: Telco gray powder coat or gold on zinc plating.
4. Approvals:
 - a. ASTM A513
 - b. UL Classified as an equipment grounding conductor.
 - c. California Electrical Code, Article 318
5. Manufacturers:
 - a. B-Line Telecom-Saunders SB-17.
 - b. Chatsworth Products Inc. 11275 series.
 - c. PW Industries
 - d. or equal.

PART 3 EXECUTION

3.1 Cable Tray Application

A. Unless otherwise noted, communications cable tray installations shall conform to the following:

1. Type CR - Within Communications Rooms (including Telecomm Building (ADF), BDF and IDF spaces) and vertical transitions from ceiling or floor sleeves are required within the Communications Room.
2. Cable Tray for voice/data communications cabling and its suspension system shall be dedicated and not shared with other cabling subsystems.

3.2 Installation:

- A. Provide all required supports, fittings and accessories for a complete system as described in NEMA VE-2, by Code, manufacturer recommendation or as shown on the plans, whichever is most restrictive.
- B. Bond sections to one another and to building ground.
- C. Access Clearance. Maintain access for use by Owner's personnel to tray as described below. Coordinate installation with work of structural, mechanical, plumbing/fire protection and electrical trades to maintain required access.
 1. Unless shown otherwise on the plans, provide a clear access of at least 24" wide along one side of each tray for use by Owner's personnel.

2. Unless shown otherwise on the plans, installation to maintain at least 12" vertical clearance over the top of each tray for use by Owner's personnel.

3.3 Support

A. Support in accordance with the most restrictive of the following:

1. Contractor's engineered means of engineered support submitted in accordance with the requirements of 27 05 00 – Common Work Results for Communications and Section 27 05 29 – Hangers and Supports for Communications Systems.
2. California Building Code, including but not limited to requirements of Volume 2, Chapter 16, Division IV, Section 1632 and Table 16-O.
3. Metallic Cable Tray: NEMA VE 2-2001, or latest edition
4. Fiberglass Cable Tray: NEMA FG-1-1998, or latest edition.

B. Provide lateral sway bracing as required by Code.

END OF SECTION

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SECTION 27 0543

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, and set up of the Communications System Raceway, Conduit and Backbone work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, contiguous working raceway systems.
- B. Communications Outside Plant Ductwork - refer to the drawings for demarcation of the work of this Project.
 - 1. Communications Outside Plant Ductwork.
 - 2. Communications Manholes
 - 3. Communications Pullboxes
 - 4. Connection of underground ductbanks to campus buildings

1.2 Related Work in Other Sections:

- A. Section 31 2317 – Trenching, Backfilling, and Compacting
- B. Section 03 3000 – Cast-In-Place-Concrete
- C. Section 27 0500 – Common Work Results for Communications Systems.
- D. Section 27 0526 – Grounding and Bonding for Communications Systems
- E. Section 27 0533 – Communications, Raceways, Boxes and Fittings

1.3 REGULATORY REQUIREMENTS

- A. In addition to requirements of Division 1, comply with the following.
 - 1. Public Utilities Commission of the State of California.
 - a. Rules for Overhead Electric line Construction, General Order No. 95 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.
 - b. Rules for Underground Electric Line Construction, General Order No. 128 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.

1.4 REFERENCES

- A. Usage: In accordance with Division 1.
- B. BICSI
 - 1. 2004 Customer Owned Outside Plant Design Manual
- C. American National Standards Institute (ANSI)

1. ANSI C80.1 1990 Rigid Steel Conduit - Zinc Coated
- D. State of California, Business, Transportation and Housing Agency, Department of Transportation (CalTrans)
1. Standard Specifications, July, 1999, or latest edition.
 2. Standard Plans, July 1999 or latest edition.
- E. National Electrical Manufacturers Association (NEMA)
- a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - b. ANSI/NEMA FB 1-2003 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
 - d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
 - e. NEMA FG 1 1-1998 Fiberglass Cable Tray Systems
 - f. NEMA ICS 6 2001 Industrial Controls and Systems Enclosures
 - g. NEMA RN 1 1998 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - h. NEMA TC 2 2003 Electrical Polyvinyl Chloride (PVC) Conduit
 - i. NEMA TC 3 1999 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - j. NEMA TC 6&8 2003 PVC Plastic Utilities Duct for Underground Installations
 - k. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
 - l. NEMA TC 9 1999 Fittings for ABS and PVC Plastic Utilities Duct for Underground Application
 - m. NEMA TC 14 1984(R 1997) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
 - n. NEMA TC 19 2001 Nonmetallic Riser U-Type Guards
 - o. NEMA VE 1 1-1998 Metallic Cable Tray Systems.
 - p. NEMA VE 2 2001 Cable Tray Installation Guidelines
2. Underwriters Laboratories, Inc. (UL)
 - a. UL 6 2004 Electrical Rigid Metal Conduit - Steel
 - b. UL 360 1986 (R 2003) Liquid-Tight Flexible Steel Conduit
 - c. UL 514A 1991 (R 2004) Metallic Outlet Boxes
 - d. UL 514B 1989 (R 2004) Conduit, Tubing, and Cable Fittings
 - e. UL 514C 1988 (R 1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - f. UL 651 1989 (R 1995) Schedule 40 and 80 Rigid PVC Conduit.

1.5 SUBMITTALS

- A. Conform with the requirements of Division 1 and Section 27 05 00 Common Work Results for Communications.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Division 1.

1.7 SEQUENCING

- A. Not Used.

PART 2 PRODUCTS

2.1 DUCTBANK CONSTRUCTION

A. PVC Conduit

1. Drawing and Spec Reference: PVC.
2. Construction:
 - a. 4" trade diameter, unless otherwise noted.
 - b. Poly-vinyl chloride.
 - c. Schedule by Application
 - 1) Straight segments, Schedule 40.
 - 2) Flat elbows, Schedule 40.
 - 3) Vertical elbows sweep up to grade, Schedule 80.
 - 4) Above grade, Schedule 80.
 - d. Elbows.
 - 1) Where innerduct liner is scheduled – CRSC.
 - 2) Elsewhere, Schedule 80.
 - 3) 90° C rated.
 - 4) Solvent welded joints, joints by pipe manufacturer.
 - e. Application.
 - 1) Soil Backfill/Direct Burial
 - a) RUS Type II, Type C or Type DB
 - b) Schedule 40.
 - 2) Concrete Encasement:
 - a) PVC Type DB-120,
 - b) RUS Type I, Type B or Type EB
 - c) Any meeting Soil Backfill/Direct Burial.
 - 3) Boring
 - a) HDPE.
 - b) RUS Type Flexible Plastic.
 - f. Performance:
 - 1) Tensile Strength: 7,000 psi at 73.4° F.
 - 2) Flexural Strength: 11,000 psi.
 - 3) Compressive Strength: 8,600 psi.
 - g. Approvals:
 - 1) RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.
 - 2) NEMA TC-2, PVC Type EPC-40 and EPC-80.
 - 3) NEMA TC-3.
 - 4) NEMA TC14 Fiberglass Conduit.
 - 5) UL 514 fittings.
 - 6) UL 651.
 - 7) ANSI C33.91.
 - h. Manufacturers:
 - 1) RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB
	Plastic	PVC Multi-Duct (2,3,4 and 6-way)

Americon International	Flexible plastic	HDPE Duct
	Plastic	PVC Type C
Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
Carlton	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete	Condux
	Plastic	Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct
Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Freedom Plastics, Inc.	Plastic	Type C
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C
J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB
SCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Driskon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct

Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

2) or equal

2.2 FITTINGS

A. Couplings, adaptors, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80 and NEMA TC 9 for type EB or DB.

B. Fitting Types

1. Expansion Fittings, 12", Metallic:
2. Function: At road or bridge expansion joints requiring up to 12" of expansion compensation.
3. Approvals:
 - a. CalTrans
4. Construction
 - a. Steel, hot dip galvanized.
 - b. Nylon wear bushings
 - c. O-ring seal
 - d. Bonding jumper
5. Manufacturers:
 - a. O-Z Gedney Type AX, Type AX-8, and Type EX fittings with Type BJ Bonding Jumper.
 - b. TVC/Vikimatic VB0285X series.
 - c. Or Equal.

C. Expansion Fittings, 6", Non-metallic:

1. Function: At road or bridge expansion joints requiring up to 6" of expansion compensation.
2. Construction
 - a. Fiberglass
 - b. Provide bonding jumper.
3. Manufacturers:
 - a. TVC Communications HW or Extra Heavy Wall Expansion Joint.
 - b. Vikimatic
 - c. FRE Composites, Inc.
 - d. Or Equal.

D. Caps, Underground Conduit Stubs

1. Provide at each location indicated for future expansion.
2. Watertight.
3. Manufacturers:
 - a. Carlon E985N
 - b. Vikimatic

E. Refer to Section 27 05 33 – Communications, Raceways, Boxes and Fittings for additional fittings.

2.3 UNDERGROUND STRUCTURES

A. Vaults, PullBoxes and Manholes, Precast, General

1. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.
2. Construction
 - a. General
 - 1) Castings shall be free from warp and blow holes that may impair strength or appearance.
 - 2) Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified.
 - 3) Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
 - 4) Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.
 - 5) The minimum concrete cover for reinforcing steel shall be 2 inches.
 - 6) All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.
 - 7) Knockouts & Windows
 - a) Thin-walled knock-out panels designed for future duct bank entrances are permitted.
 - b) Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.
 - c) Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.
 - d) Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.
 - e) Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.
 - 8) Extension Rings
 - a) Provide extension rings as-required to extend from finished grade to communications utilities.
 - 9) Bottom and Drain Sumps
 - a) Provide solid concrete bottom surface.
 - b) Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.
3. Joints:
 - a. Provide tongue-and-groove or shiplap joints on mating edges of precast components.
 - b. Design joints to firmly interlock adjoining components and to provide waterproof junctions, and adequate shear transfer.
 - c. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.
4. Frames and Covers
 - a. Covers to match across all utilities.
 - b. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.
 - c. Labeling

- 1) Provide labeling as follows:
 - a) "Communications"
 - b) Owner's Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.
- 2) Labeling shall be:
 - a) Cast in concrete lids
 - b) Written in weld on steel lids
 - c) Alternatively, for pedestrian grade vault lids and for the vault number only, provide 1/8" min. thickness lamacoid label, rivet attached to box top in recess area below surface of lid.

5. Pulling-In-Irons

- a. Steel bars bent in the form indicated and cast in the walls and floors.
- b. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.
- c. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.
- d. Provide cable racks, including rack arms, minimum two (2) 12" arms each manhole or vault face.

B. Underground Pull Boxes and Vaults, Concrete

1. Drawing and Specification References:

- a. PB1P
- b. PB1T
- c. PB2P
- d. PB2T
- e. PB3T

2. Minimum Size

- a. As scheduled on the drawings. Provide scheduled or larger size.

3. Lid Construction:

- a. As scheduled on the plans

4. Cover Components

- a. PB1 and PB2 Size: One piece construction
- b. PB3 Size: Two piece hinged lids with torsion spring lifters.

5. Manufacturers:

- a. Brooks Products
 - 1) 1P & 1T: 5 Series and extension rings as required
 - 2) 2P & 2T: 67 Series and extension rings as required
 - 3) 3T: 400 Series with 11C Type Lid.
- b. Jensen PreCast
 - 1) PB1P: P9 with FL9D lid, P9BA base and extension rings as required.
 - 2) PB1T P9 with P9-61 lid, P9BA base and extension rings as required
 - 3) PB2P: P36 with FL36D cover, P36BA base and extension rings as required
 - 4) PB2T: P36 with P36-61D lid, P36BA base and extension rings as required
 - 5) PB3T: 35TA
- c. Utility Vault Company, Inc./Oldcastle Precast
 - 1) PB3T: PTS-3660, with H-20-44 loading cover, with 3660-06 and 3660-12 extensions as required.
- d. Associated Concrete Products
- e. Forni Corporation.

- f. Or equal.

2.4 MISCELLANEOUS UNDERGROUND PRODUCTS

A. Cable Warning Tape

1. Provide
 - a. 6 inches wide minimum.
 - b. 5 mil plastic.
 - c. Metallic backing at least 10 feet o.c.
 - d. 1 mil metallic foil core.
 - e. Orange in color
 - f. Suitable for buried applications.
 - g. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.
2. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Vikimatic
 - c. Or equal.

B. Pull Rope

1. At least 3/8 inch diameter polyethylene.
2. 200 pound strength.
3. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Vikimatic
 - c. Or equal.

C. Length Marked Tape

1. Provide 1/2 inch flat tape with sequential markings in whole feet.
2. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Greenlee
 - c. Vikimatic
 - d. Or equal.

D. Conduit Plugs

1. Provide universal blank duct plug type, with eye for tying rope and tape.
2. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Condux International, Inc.
 - c. Or equal.

E. Line Marker Post

1. Orange polyethylene, post height 4 feet above surface.
2. Soil anchor.
3. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Vikimatic
 - c. Or equal.

F. Conduit Spacer, Trench

1. Construction
 - a. Non-metallic.
 - b. Sized to snap around conduits as shown on Drawings.
 - c. Interlocking.
2. Manufacturers:
 - a. Underground Devices Wunpeece.
 - b. GS Industries Underground Products Spacer System.
 - c. Or equal.

G. Pulling In Irons

1. 7/8" Diameter
 - a. 6" exposed length minimum after imbedment
 - b. RUS approved
2. Manufacturer
 - a. Cooper Power Systems
 - b. Or equal.

H. Cable Racks & Supports

1. Construction:
 - a. Non-metallic
 - b. 12" minimum rack arms
 - c. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into Owner's existing vaults, where indicated.
2. Approvals
 - a. RUS
 - b. NEMA
3. Manufacturers:
 - a. Underground Devices
 - b. Inwesco
 - c. Cooper Power Systems
 - d. Or Equal

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Refer to the most restrictive of the Code, the manufacturer's instructions, these specifications and the relevant NEMA, CalTrans or RUS guidelines and conform.

3.2 CONDUIT APPLICATION

- A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Underground Ductbanks, Concrete Encased
 - a. PVC

- B. Exterior, Exposed:

1. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.

2. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

C. Embedded in Concrete

1. RSC or rigid non-metallic conduit.
2. PVC

D. In Utility Tunnel

1. RSC
2. CRSC
3. IMC

3.3 RACEWAY INSTALLATION, GENERAL

- A. Refer to Section 27 05 33 – Conduits and Backboxes for Communications Systems

3.4 UNDERGROUND CONSTRUCTION:

A. Duct and Conduit Placement.

1. Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.
2. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
3. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

B. Duct Bank.

1. Duct Entrance Arrangement - Conform to Table 3.27 and applicable arrangement diagrams 3.57-3.64 of 2004 BISC Customer Owned Outside Plant Design Manual.
2. Terminate conduits in end-bells where duct lines enter underground structures.
3. Stagger conduit joints by rows and layers to strengthen the duct bank.
4. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.
5. As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until

- conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.
6. Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of **30"** below finished grade or as required to conform to local utility requirements. Where new trenching is required, backfill and compaction requirements shall be as defined in other Sections.
 7. Where concrete encasement indicated, construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade.
- C. Where conduit runs under existing roads, cut and patch the pavement as indicated.
 - D. Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a 3/8 inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.
 - E. Partially Completed Duct Banks. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.
 - F. Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement.
 - G. Mark locations of future provision underground raceways by pre-cast reinforced concrete pullbox set flush in ground with stamped brass disk identification plate tied to conduit end with "Ty-Wrap", "Quick-Wrap" or equal.
 - H. In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the Owner's Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Owner's Representative of any such damage.
 - I. At twelve inches below grade, place specified warning tape continuously.

END OF SECTION

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SECTION 27 0548

NOISE AND VIBRATION CONTROLS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Provisions of:

1. Flexible communications raceway connections to vibrating machinery
2. Sealing of communications device boxes related installed in sound rated walls.
3. Coordination of airtight installation requirements at Mechanical and Electrical Rooms and/or duct enclosures.

PART 2 PRODUCTS

2.1 FLEXIBLE COMMUNICATIONS CONNECTIONS:

A. Make communications connections to vibrating equipment flexible as follows:

1. For conduit over 1" O.D. make communications connections to vibrating equipment via a flexible expansion/deflection conduit coupling sized as required. Coupling shall have flexible and watertight outer jacket, internal grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with threads to fit standard threaded metal conduit.
2. Manufacturers:
 - a. XD Xpansion Deflection Coupling by Crouse-Hinds of Syracuse, N.Y.
 - b. Type DF Expansion and Deflection fitting by Spring City Electrical Mfg. Co.
 - c. or equal.

2.2 J-BOX MASTIC:

A. At all electrical boxes penetrating sound isolating partitions, STC 40 or greater, utilize sheet form adhesive mastic as directed elsewhere herein

B. Manufacturers:

1. Insul-Pad by Dottie Corp.
2. Duct-Seal by Gardner Bender, Inc.
3. or equal.

2.3 RESILIENT PENETRATIONS:

A. For conduit:

1. Sleeves: Sleeves of appropriate gage galvanized sheet metal shall be formed to at least the thickness of the penetrated construction and 3/4" to 1" larger in each cross-sectional dimension than the penetrating element.
 - a. Manufacturers:
 - 1) Century-Line Sleeves by Thunderline Corporation
 - 2) Custom by Contractor

- 3) or equal.
2. Batt: Glass fiber of batt or mineral wool, 1 to 3 lb./cu. ft. density.
 - a. Manufacturers
 - 1) Certain-Teed
 - 2) Johns-Manville
 - 3) or equal.
 3. Acoustical Sealant:
 - a. Manufacturers
 - 1) DAP
 - 2) Pecora
 - 3) or equal.
 4. Firestop Sealant:
 - a. Where required, resilient firestop caulking may be used in lieu of Acoustical Sealant when installed in strict conformance with the manufacturer's directions. Fully hardened firestop caulk shall develop a Shore A hardness of no greater than 35. Refer to the requirements of Section 27 05 33.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS, CONNECTION TO VIBRATING EQUIPMENT

- A. The Contractor shall not install any vibrating equipment or conduit attached thereto which makes rigid contact with the "building" unless it is approved in this specification or by the Owner's Representative. "Building" includes, but is not limited to slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems.
- B. Prior to installation, the Contractor shall bring to the Owner' Representative's attention any conflicts between trades which will result in unavoidable rigid contact at equipment, conduit, piping, ducts, etc., as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

3.2 INSPECTION OF CONDITIONS:

- A. Examine related Work and surfaces before starting Work of this Section. Report to the Owner's Representative, in writing, conditions which will prevent proper provision of this work. Beginning the Work of this Section without reporting unsuitable conditions to the Architect constitutes acceptance of such conditions by Contractor. Perform any required removal, repair, or replacement of this Work caused by unsuitable conditions at no additional cost to the Owner.
- B. Coordination
 1. Coordinate with the work of the Base Building Construction Contract. Coordinate Work of this Section with all other impacted trades.

3.3 INSTALLATION REQUIREMENTS, FLEXIBLE ELECTRICAL CONNECTIONS

- A. The installation of flexible electrical connections to vibration isolated equipment shall in no way impair or restrain the function of the vibration isolation installed by the work by Others.

1. Using gross slack. Install flexible conduit in a grossly slack loop form or shallow "U" form. Install stranded conductors with sufficient slack to accommodate maximum possible movement.
2. Using flexible coupling. The flexible coupling shall be free and not in contact with any nearby building construction and shall be installed slack, and free of strain in any direction. Install stranded conductors as above

3.4 INSTALLATION REQUIREMENTS, J-BOX MASTIC

- A. Application: All Communications Systems work in sound isolating assemblies, including but not limited to residential rooms, offices, mechanical rooms, electrical rooms and related to utilize backboxes for all services, including but not limited to low voltage communication. Installation of backboxes to conform with following:
1. Space outlet boxes on opposite faces of the wall by more than 24" o.c. Where daisy chained conduits indicated on the plans, connect such boxes by slack flexible conduit (2 times longer than distance between outlets).
 2. Cutouts for electrical boxes and penetrating piping/conduit shall be no more than 1/4" oversize.

3.5 INSTALLATION REQUIREMENTS, RESILIENT PENETRATIONS

- A. Penetrations included in this Section of the Specifications include all communications conduit connected to vibrating equipment within 30 feet of such equipment
- B. Method for round or rectangular penetrations.
1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below and vertical framing between and to the sides, as required. Provide the above, escutcheon plates and such related construction as is necessary to make the penetrated structure as solid and massive near the penetrations as the surrounding construction.
 2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster or drywall compound full depth and all around - but only to a maximum width of 1/2" - or the requirements of the above paragraph shall not have been satisfied.

3.6 MECHANICAL AND ELECTRICAL ROOMS REQUIREMENTS

- A. All mechanical and electrical rooms, plenums, duct shafts and drywall duct enclosures and other enclosures of high noise sources shall be constructed airtight. This means that every precaution shall be taken to maintain construction completely airtight around a room so designated. Construction joints, duct penetrations, electrical boxes, frames, supports, cabinets, doors, access panels, fixtures, etc., all shall be built or installed in such a manner as to prevent sound transmission through any construction enclosing a room horizontally or vertically. Appropriate lintels, frames, blocking, escutcheons, grouting, gaskets, packing, caulking, taping, filling, etc., all shall be employed to prevent sound transmission. Refer to requirements of this Section for Resilient Penetrations.

END OF SECTION

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SECTION 27 0553

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY:

- A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling on, or adjacent to, all cabling, connectors, innerduct, faceplates, jacks, receptacles, controls, fuses, circuit breakers, patching jacks, and racks.
- B. This section includes minimum requirements for the following:
 - 1. Labeling Communications Cabling
 - 2. Labeling Closet Hardware
 - 3. Labeling Work Stations
 - 4. Labeling Pathways, Spaces, Grounding and Bonding.
- C. Refer to detailed plans for additional requirements.
- D. Clearly and distinctly indicate the function of the item.
- E. Coordinate with Record Drawings

1.2 REFERENCES:

- A. Usage: In accordance with Section 01 1100 – Summary of Work.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM D 709(2001) Laminated Thermosetting Materials
- C. Electronic Industries Alliance (EIA)
 - 1. ANSI/TIA/EIA-606B (2016) - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- D. Underwriters Laboratories (UL)
 - 1. UL 969 (1995; R 2001) Marking and Labeling Systems

1.3 QUALITY ASSURANCE

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA-606-B-2016 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - 2. ANSI/TIA-569-C-2012 Telecommunications Pathways and Spaces
 - 3. ANSI/TIA/EIA-568-C.1-2009 Commercial Building Telecommunications Cabling Standard.
 - 4. BICSI Telecommunications Distribution Methods Manual, 13th Edition.
 - 5. UL 969 (1995; R 2001) Marking and Labeling Systems.

1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 - Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 01 6000 – Product Requirements.

PART 2 PRODUCTS

2.1 COMMUNICATION CABLING LABELS, INTERIOR

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
- D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.
- F. Manufacturers:
 - 1. Cable Type – 4 pair UTP
 - a. Brady TLS2200 labels – PTL-31-427,PTL-32-427
 - b. Brady Laser tab labels – LAT-18-361, LAT-53-361
 - c. Hubbell
 - d. Leviton
 - e. Panduit.
 - f. or equal.
 - 2. Cable Type – 4 pair STP
 - a. Brady TLS2200 labels – PTL-21-427
 - b. Brady Laser tab labels – LAT-19-361
 - c. Hubbell
 - d. Leviton
 - e. Panduit.
 - f. or equal.
 - 3. Cable Type – 25 pair copper
 - a. Brady TLS2200 labels – PTL-21-427
 - b. Brady Laser tab labels – LAT-19-361
 - c. Panduit.

- d. or equal.
- 4. Cable Type – 50 pair copper
 - a. Brady TLS2200 labels – PTL-33-427
 - b. Panduit.
 - c. or equal.
- 5. Cable Type – 100 pair copper
 - a. Brady TLS2200 labels – PTL-34-427
 - b. Brady
 - c. Panduit.
 - d. or equal.
- 6. Cable Type – 2 strand fiber
 - a. Brady TLS2200 labels – PTL-19-427
 - b. Brady Laser tab labels– LAT-17-361
 - c. Panduit.
 - d. or equal.
- 7. Cable Type – 4-12 strand fiber
 - a. Brady TLS2200 labels – PTL-21-427
 - b. Brady Laser tab labels – LAT-19-361
 - c. Panduit.
 - d. or equal.
- 8. Cable Type – RG-6 Coax
 - a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
 - b. Brady Laser tab labels –LAT-18-361, LAT-53-361
 - c. Panduit.
 - d. or equal.
- 9. Cable Type – RG-59 Coax
 - a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
 - b. Brady Laser tab labels – LAT-18-361, LAT-53-361
 - c. Panduit.
 - d. or equal.
- 10. Cable Bundles
 - a. Brady TLS2200 labels – PTL-12-109
 - b. Panduit.
 - c. or equal.

2.2 COMMUNICATIONS CABLE LABELS, OUTSIDE PLANT

A. Cable Tags in Manholes, Handholes, and Vaults

- 1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.

- a. The tags shall be polyethylene.
 - b. Machine printed - Do not provide handwritten letters.
2. Polyethylene Cable Tags
- a. Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F.
 - b. Provide 0.05 inch (minimum) thick black polyethylene tag holder.
 - c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
 - d. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background.
 - e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
3. Manufacturers:
- a. Panduit
 - b. Brady
 - c. or equal.

2.3 CLOSET HARDWARE LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Where insert type labels are used provide clear plastic cover over label.
- D. Manufacturer:
 1. Copper Patch Panels
 - a. 4 port group
 - 1) Brady Laser tab labels – 2.8" x 0.375" LAT-43-707
 - 2) Hubbell XPLPPA series
 - 3) Leviton
 - 4) Panduit.
 - 5) or equal.
 - b. 6 port group
 - 1) Brady Laser tab labels – 3.6" x 0.375", LAT-44-707
 - 2) Hubbell
 - 3) Leviton
 - 4) Panduit.
 - 5) or equal.
 - c. Individual port
 - 1) Brady

TLS2200 labels – 0.5" x 0.375" white, PTL-44-422
Laser tab labels – 0.5" x 0.375" white, LAT-45-707
TLS2200 labels – 0.5" x 0.375" clear, PTL-44-430
Laser tab labels – 0.5" x 0.375" clear, LAT-45-712
TLS2200 labels – 0.5" x 0.5" white, PTL-7-422
Laser tab labels – 0.5" x 0.5" white, LAT-46-707
TLS2200 labels – 0.5" x 0.5" clear, PTL-7-430
Laser tab labels – 0.5" x 0.5" clear, LAT-46-712

- 2) Hubbell
- 3) Leviton
- 4) Panduit.
- 5) or equal
- d. Patch Panel Name Label.
 - 1) Hubbell XOLPPID Series
 - 2) Brady
 - 3) Leviton
 - 4) Panduit
 - 5) or equal.
2. Non-keystone based fiber patch panels
 - a. Hubbell XPLFOSEPAW
 - b. Brady
 - c. Leviton
 - d. Panduit
 - e. as provided with Patch Panel by the manufacturer
 - f. or equal.
3. 110 blocks
 - a. Brady Laser tab labels – 7.9" x 0.475" (200.6mm x 12.07mm), LAT-177-124
 - b. Hubbell XPL110 series.
 - c. Leviton
 - d. Panduit.
 - e. or equal.

2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Manufacturers:
 1. Brady Corporation
 - a. TLS2200 labels

- 1) PTL-20-422, Size 2.0" x 1.0"
- 2) PTL-22-422, Size 3.0" x 1.0"
- 3) PTL-37-422, Size 3.0" x 1.9"
- 4) PTL-23-422, Size 4.0" x 1.0"
- 5) PTL-38-422, Size 4.0" x 1.0"
- b. Laser tab labels
 - 1) LAT-13-747, Size 1.875" x 0.833"
 - 2) LAT-24-747, Size 1.75" x 1.0"
 - 3) LAT-32-747, Size 3.0" x 0.9 "
 - 4) LAT-33-747, Size 2.0" x 1.437"
 - 5) LAT-34-747, Size 3.0" x 1.437"
- c. Continuous tape for TLS2200
 - 1) PTL-8-422, Size 0.5" white polyester
 - 2) PTL-8-430, Size 0.5" clear polyester
 - 3) PTL-8-439, Size 0.5" white vinyl
 - 4) PTL-42-439, Size 1.0" white vinyl
 - 5) PTL-43-439, Size 1.9" white vinyl
2. Panduit.
3. or equal.

2.5 WORKSTATION LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Where insert type labels are used provide clear plastic cover over label.
- D. Manufacturers:
 1. Brady Corporation
 - a. Desi-strip inserts
 - 1) TLS2200 labels –1.9"x0.375" white, PLT-40-412
 - 2) Laser tab labels –1.9"x0.375" white, LAT-176-124
 - b. Location ID
 - 1) TLS2200 labels - 1.0" x 0.375" white, PTL-16-422
 - 2) Laser tab labels –1.0" x 0.375" white, LAT-47-707
 - 3) TLS2200 labels- 1.0" x 0.375" clear, PTL-16-430
 - 4) Laser tab labels –1.0" x 0.375" clear, LAT-8-712
 - 5) TLS2200 labels- 1.0" x 0.5" white, PTL-17-422
 - 6) Laser tab labels –1.0" x 0.5" white, LAT-7-707
 - 7) TLS2200 labels- 1.0" x 0.5" clear, PTL-17-430

- 8) Laser tab labels- 1.0" x 0.5" clear, LAT-7-712
 - 9) TLS2200 labels- 1.5" x 0.375" white, PTL-45-422
 - 10) Laser tab labels- 1.5" x 0.375" white, LAT-47-707
 - 11) TLS2200 labels- 1.5" x 0.375" clear, PTL-45-430
 - 12) Laser tab labels-1.5" x 0.375" clear, LAT-47-712
 - 13) TLS2200 labels- 1.5" x 0.5" white, PTL-29-422
 - 14) Laser tab labels- 1.5" x 0.5" white, LAT-47-707
 - 15) TLS2200 labels- 1.5" x 0.5" clear, PTL-29-430
 - 16) Laser tab labels-1.5" x 0.5" clear, LAT-47-712
- c. Outlet/Jack ID
 - 1) TLS2200 labels -0.5" x 0.375" white, PTL-44-422
 - 2) Laser tab labels – 0.5" x 0.375" white, LAT-45-707
 - 3) TLS2200 labels - 0.5" x 0.375" clear, PTL-44-430
 - 4) Laser tab labels –0.5" x 0.375" clear, LAT-45-712
 - 5) TLS2200 labels - 0.5" x 0.5" white, PTL-7-422
 - 6) Laser tab labels- 0.5" x 0.5" white, LAT-46-707
 - 7) TLS2200 labels - 0.5" x 0.5" clear, PTL-7-430
 - 8) Laser tab labels - 0.5" x 0.5" clear, LAT-46-712
 - d. General Use Labels
 - 1) TLS2200 labels - 0.375" cont. white, PTL-46-422
 - 2) TLS2200 labels - 0.375" cont. clear, PTL-46-430
2. Hubbell
 - a. Location ID
 - 1) Desi-Strip Style
XPLFP10W
 - 2) Adhesive
XPLFPA10W, XPLFPA10W,
 - b. Outlet/Jack ID
 - 1) XPLIPA10W, XPLIPA10C
 3. Leviton
 4. Panduit.
 5. or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Apply labeling to clean surfaces free of oil, dust, solvents or loose material.
- B. Apply after Project painting in area of application is complete.

- C. Apply to locations where labeling will not be damaged, covered over or in the way of the ordinary maintenance and operation of the installed communications infrastructure or system.
- D. Apply labeling right side up, parallel to major edges of surfaces to which it is applied. When no line is evident, apply parallel to floor line. Correct conditions of labeling applied out of true.
- E. Protect installed labeling from damage.
- F. Replace labeling that is defaced, illegible or peeling off of the surface to which it is applied.

3.2 WORKSTATION JACK, CABLE AND PATCH PANEL ASSIGNED CIRCUIT NUMBERS

- A. The Owner will provide the Contractor copies of the Contract Drawings showing station outlets with Owner assigned data & voice jack ID numbers. Label all installed work according to this master set.
- B. The cover plate area directly above and beneath the jacks are the labeling areas. In the top area, using the specified means, label the faceplate number assigned on the contract documents.
- C. For above-ceiling outlets, in addition to the outlet labeling, the contractor shall provide an outlet label on the nearest T-bar suspension beam.

3.3 IDENTIFICATION & LABELING

A. Pathways

1. Pathways shall be marked at each endpoint and at all intermediate pull or junction boxes. In the case of partitioned pathways (i.e. innerduct) each partition shall have a unique identifier.
2. Label pathways using the appropriate abbreviation and a number.
3. Use adhesive type labels.

B. Labels shall be affixed at the entry to all telecommunications rooms and spaces (Includes entrance facilities, communication equipment rooms, communication equipment spaces and work areas)

1. Use adhesive type labels for all communications space labeling,
2. Affix labels to entrance doors – coordinate location with Owner's Representative.

C. Cables

1. Horizontal and Indoor Backbone Cables shall be marked within 12" of each endpoint or to innerduct in which the cable is installed.
2. Except where installed in innerduct or conduit, all backbone fiber optic cable shall have affixed to the outer jacket, labels of a bright color that contain at least the legend "FIBER OPTIC CABLE." These labels must be affixed at separations no greater than 10 ft.
3. Within every manhole/vault/pullbox and within 4 ft of the entrance into a building every backbone cable's assigned identifier shall be affixed to either the cable's outer jacket or to innerduct in which the cable is installed.
4. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.
5. Label cables using the appropriate circuit ID.
6. Use adhesive type labels for all communications cable labels.

7. Affix labels to cables – marking cable is not permitted.
 8. Where cable is fully encased in innerduct label the outside of the innerduct with the cable label and, where the contents are fiber optic cabling, the "FIBER OPTIC CABLE" label.
 9. Labels for backbone cables shall be:
 - a. WHITE for voice copper feeder
 - b. YELLOW for data fiber feeder
 - c. RED for FA fiber feeder
 - d. BLUE for AV fiber feeder
- D. Patch Panels
1. Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it. All fiber optic cable patch panels shall be labeled with both the pair count of every fiber pair, the cable's assigned identifier, and where shown on the plans, the patch panel's assigned identifier.
 2. If not shown on the Contract Documents, Owner's Representative will provide specific circuit ID information.
 3. Category rated patch panels shall be labeled with an identifier, individual ports shall be labeled to indicate circuit and identification of station plate in which the circuit terminates.
- E. Workstations
1. All faceplate labels shall indicate the faceplate number and the circuit ID for each cable that it houses
 2. For faceplates where insert type labels are used install clear plastic cover over preprinted or Laser printed type label.
 3. For faceplates without insert type labels use adhesive type labels affix labels to faceplate – marking faceplates is not permitted.
 4. Patch cords installed under the work of this Project shall be labeled at each endpoint using the appropriate circuit ID.
 5. Use adhesive type labels for all communications cable labels.
 6. Affix labels to cables – marking cable is not permitted.
- F. Grounding and Bonding
1. The TMGB(s) (telecommunications main ground bar) shall be labeled as such with an adhesive type label(s) affix label(s) to TMGB.
 2. The conductor connecting the TMGB (telecommunications main ground bar) to the building ground shall be labeled at each end with an affixed label in a visible location as close as practicable to the bonding point at each end of the conductor.
- G. Firestopping
1. Each firestopping location shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 12 in. of the firestopping material.

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SECTION 27 1000

STRUCTURED CABLING, BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. This Section defines common means and methods for the work of the following Sections:
 - 1. Section 27 1113 – Communications Entrance Protection
 - 2. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
 - 3. Section 27 1119 – Communications Termination Blocks and Patch Panels
 - 4. Section 27 1123 – Communications Cable Management
 - 5. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
 - 6. Section 27 1300 – Communications Interior Backbone Cabling
 - 7. Section 27 1500 – Communications Horizontal Cabling
- B. Related work specified in other Sections
 - 1. Section 26 0050 – Basic Electrical Materials and Methods

1.2 RELATED DOCUMENTS

- A. Section 27 0500 – Common Work Results for Communications applies to the work of this Section.

1.3 REFERENCES

- A. In Addition to the requirements of Section 27 0500 – Common Work Results for Communications, conform to the applicable portions of the following standards agencies:
 - 1. American Society For Testing and Materials (ASTM)
 - a. ASTM A228/A228M-02 Steel Wire, Music Spring Quality.
 - 2. Bellcore
 - a. TR-NWT-000253 Intermediate Reach, 1, OC3
 - 3. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) Telecommunications Industry Association/Electronic Industries Association (TIA/EIA)
 - a. EIA/TIA-526-7 OFSTP-7 - Optical Power Loss of Installed Single-Mode Fiber Cable Plant (r12/2008)
 - b. ANSI/TIA/EIA-568-C.1-2009 Commercial Building Telecommunications Cabling Standard
 - c. ANSI/TIA-568-D Optical Fiber Cabling Components Standard (2016)
 - d. ANSI/TIA-569-C-2012 Telecommunications Pathways and Spaces
 - e. ANSI/TIA/EIA-606-B-2016 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - 4. Federal Communications Commission (FCC)

- a. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (1982 issue or latest revision) (47 CFR 68) .
- 5. Institute of Electrical and Electronic Engineers
 - a. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms
- 6. Insulated Cable Engineers Association (ICEA)
 - a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.
 - b. ICEA S-83-596(2001) Fiber Optic Premises Distribution Cable
- 7. National Electrical Manufacturers Association (NEMA)
 - a. NEMA WC 63.1(2000) Twisted Pair Premise Voice and Data Communications Cables
- 8. National Fire Protection Association (Nfpa)
 - a. NFPA 70 National Electrical Code
- 9. Underwriters Laboratories, Inc. (UL)
 - a. UL 444(2002; Bul. 2002, 2003) Communications Cables
 - b. UL 910(1998) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
 - c. UL 1286(1999; R 2004) Office Furnishings
 - d. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.4 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in
 - 1. ANSI/TIA/EIA-568-C.1
 - 2. ANSI/TIA/EIA-606-B
 - 3. IEEE Std 100 and
 - 4. in this Section.
- B. Campus Distributor (CD) - A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)
- C. Building Distributor (BDF) - A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)
- D. Floor Distributor (FD) - A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)
- E. Intermediate Distribution Facility (IDF) or Telecommunications Room (TR) - An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.
- F. Entrance Facility (EF) (Telecommunications) An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

- G. Entrance Room (ER) (Telecommunications) - A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.
- H. Open Cable - Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.
- I. Open Office - A floor space division provided by furniture, movable partitions, or other means instead of by building walls.
- J. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.5 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 - Common Work Results for Communications.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Section 01 6000 – Product Requirements, Section 27 0500 – Common Work Results for Communications Systems and the following:

- B. Shipping Conditions:

1. All cable shall be shipped on reels or manufacturer supplied "handy boxes".
2. The diameter of the drum shall be at least 13 times the diameter of the cable.
3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.

- C. Storage:

1. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.
2. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.
3. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.
4. Equipment, other than cable, to be delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 PERFORMANCE STANDARDS

A. Voice Copper Plant:

1. Where specified termination jack is indicated as Category 6A RJ-45, and specified distribution cabling similarly specified as Category 6A, conform to Category 6A standards below.

B. Category 6A Copper Data Service Cabling Plant:

1. To EIA/TIA standards referenced herein for Category 6A. Performance requirement is for circuit end-to-end.

C. Fiber Optic Cabling:

1. Optical Budget, any end to end link - not to exceed the sum of the following:
 - a. The specified cable performance, pro-rated for total link distance.
 - b. Single Mode:
 - 1) 0.06 dB for each fusion splice

1.8 TESTING

A. General

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
2. Test each end to end cable link.
3. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and Owner's Representative approved, forms; and in electronic format approved by the Owner's Representative.
4. Email PDF copies or save on USB sticks.
5. Provide registered testing software used for the actual tests to the Owner for review of test data.

B. Test Equipment:

1. Provide in conformance with the applicable requirements of 27 0500 - Common Work Results for Communications .
2. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
 - a. Category 6A Cable Pair Tester – Fluke/Microtest , Agilent or equal.
 - b. Outside Plant Voice Cabling Plant tester - capable of detecting shorts, opens, reversals, mis-wiring and crosstwists. (Siemon STM-8, Fluke or equal).
 - c. Tone Test Sets.
 - d. Optical power meter (HP, Corning Cable Systems, Fluke or equal).
 - e. Site portable communications systems (walkie-talkie, cell phone or similar).
 - f. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

C. Station Wiring, General

1. Test station wire only after all pairs of station wire in an work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring and installed in final faceplate/patch panel position.
 2. Correct any and all transpositions found. Retest.
 3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.
- D. Inside Category 6A Cabling.
1. Using the listed Category 6A cable test set, test and submit report on the parameters specified for Category 6A cabling in this Section. Report whether tested link passes or fails the Category 6A standards in Part 2 of this Section.
 2. As a minimum, all cables shall be tested with a Level III test set for Category 6A compliance with the following tests: wire map, length, insertions loss, NEXT loss, PSNEXT loss, ELFEXT, PSELFEXT, return loss, propagation delay and delay skew.
 3. Note exceptions to required Category standards. Remedy and retest.
- E. Telephone: Outside Plant, Inside Riser Wire:
1. General:
 - a. A new cable shall be tested only after all wires within the cable have been terminated at both ends.
 - b. For unshielded cable, "measurements to ground" means an electrical connection to the Telecommunications Ground Bus, building steel, electrical metallic conduit or a water pipe.
 - c. The Contractor shall correct all defects possible.
 2. Test procedures:
 - a. TEST #1 – Continuity:
 - 1) Meter set for 20 ohm full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.
 - 2) The difference between the largest and the smallest resistance reading from each pair in the cable shall be no more than 10 percent of the largest reading.
 - b. TEST #2 - Balance, Polarity and Conductor Transpositions:
 - 1) Upon passing Test #1, the tester at one end of cable shall ground tip side of each pair in turn. The tester at other end of cable reads resistance to building ground of same conductor.
 - c. REQUIREMENT: Reading for each tip conductor in pair of approximately one-half the loop resistance value from Test #1.
 3. Test Report:
 - a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions found, as well as corrective action taken to correct any found opens, shorts, or transpositions.
- F. Fiber Optic Cabling.
1. Perform fiber optic cable testing on all installed fiber optic cabling. Submit test results. Notify Owner's Representative in writing at least 48 hours in advance that fiber optic cable testing shall commence. Submit calibration certification for testing equipment to be used.
 2. Submit test report no later than five days after the cables are tested.

3. Test and submit Power Meter attenuation assessments test results on each fiber, in each cable, and in both directions under final installation conditions. Submit with the following information:
 - a. Date of test
 - b. Name of test personnel
 - c. Fiber cable type and part number
 - d. Fiber number
 - e. TX wavelength
 - f. TX location
 - g. RX location
 - h. TX model and serial number
 - i. RX model and serial number
 - j. Attenuation in dB
4. Acceptance Tests
 - a. Power Meter Attenuation Test
 - 1) Perform on all fiber cabling segments.
 - 2) Method: Perform the following measured attenuation tests using the method B of ANSI/EIA/TIA-526-7 for singlemode strands. Measure the attenuation of the fiber optic network inclusive of all splices and patch points called for on the Drawings.
 - 3) Measure attenuation between all the coupling points (when applicable) using the insertion method.
 - 4) Perform a reference measurement in dBm to determine the injection power level of the stabilized source. Reference cable shall have the same core diameter as strands under test. Connect the optical source directly to the optical power level meter using 2 reference cables and a coupler.
 - 5) Connect the optical source to the strand under test using 1 of the 2 reference cables attached to the strand's terminal coupler.
 - 6) Connect the optical power level meter to the other end of the strand under test through its terminating coupler using the other reference cable.
 - 7) Obtain the measured attenuation (in dB) by subtracting the reference level (dBm) from the received level (dBm).
 - 8) Periodically during the acceptance tests, check and document the reference level.
 - 9) Test each fiber link for overall attenuation from end to end in both directions.
 - 10) Perform the attenuation acceptance test at the 850 nm wavelength for multi-mode and 1310 nm for single-mode.
 - b. OTDR Distance and Attenuation Assessments
 - 1) Perform on all cabling segments 1000 feet or longer.
 - 2) Perform in accordance with the requirements of:
 - ANSI/EIA/TIA-568-B.1
 - ANSI/EIA/TIA-568-B.3
 - TIA/EIA-455-59-A

- 3) Test and submit strip charts and/or tracer recordings on all strands in each tube in every cable in both directions. Submit with the following information:

- Date of test
- Name of test personnel
- Test wavelength
- Pulse duration(s) and scale range(s)
- Index of refraction
- Fiber cable type and part number
- Fiber tube and/or fiber strand number
- Direction of test
- Overall distance
- Attenuation in dB

- c. Maximum back reflection of 26 dB.

PART 2 PRODUCTS

2.1 COMMUNICATIONS CABLES AND RELATED

A. GENERAL:

1. Cabling shall be UL listed for the application and shall comply with EIA TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3 and NFPA 70.
2. Ship cable on reels and/or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.
3. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
 - a. At risers and plenums, provide type CMP or OFNP cabling.

PART 3 EXECUTION

3.1 GENERAL

- A. All system cabling and terminations be installed in accordance with the manufacturer's instructions and as shown.
- B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.
- C. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- D. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
- E. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

- F. Correct unacceptable wiring conditions including but not limited to:
 1. Deformed, brittle or cracked insulation.
 2. Torn or worn cable jacket.
 3. Excessively scored cable jackets.
 4. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
 5. Ungrommated, unbushed, or uninsulated wire or cable entries.
 6. Deformation or improper radius of wire or cable.

3.2 SPLICING

- A. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
 1. At designated splices, maintain conductor color code across all splices.
 - a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
 - b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

3.3 PULLING IN

- A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
- C. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

3.4 SUPPORT

- A. Separation. Conform to the following table with respect to separation from power and radio frequency (RF) sources. Provide at least twice the listed separation at fluorescent light fixtures, ballasts and similar high intensity Electromagnetic Field sources, including but not limited to motors, transformers and copiers.

Separation of Telecommunications Cabling and Pathways from 480 V or Lower Power Lines

Condition	Minimum Separation Distance		
	< 2kVA	2-5 kVA	> 5kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	5 in.	12 in.	24 in.

Unshielded power lines in proximity to a grounded metal conduit pathway.	2.5 in.	6 in.	12 in.
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Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.	N/A	3 in.	6 in.
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- B. Support: Provide support for all cabling. Conform to the restrictions of the National Electric Code and Section 27 05 29.

END OF SECTION

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SECTION 27 1113
COMMUNICATIONS ENTRANCE PROTECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Section includes provision of lightning protection of all outside plant copper cabling installed under the work of this Project .
- B. Related Work Under Other Sections
 - 1. Related Sections:
 - a. Section 27 0500 – Common Work Results for Communications
 - b. Section 27 0526 – Grounding and Bonding for Communications Systems

1.2 REFERENCES

- A. In Addition to the requirements of Section 27 0500 - Common Work Results for Communications and 27 1000 - Structured Cabling, Basic Materials and Methods, conform to the applicable portions of the following standards agencies:
 - 1. Underwriters Laboratories, Inc. (UL)
 - a. UL 497 (Dec. 15, 1978, 4th Ed.; Rev. thru Jun. 14, 2004) Protectors for Paired Conductor Communication

1.3 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 05 00 - Common Work Results for Communications.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 27 1000 – Structured Cabling, Basic Materials and Methods.

1.5 QUALITY ASSURANCE

- A. Unless otherwise noted, protect each pair of each end of each outside plant cable installed under the work of this project.

PART 2 PRODUCTS

2.1 WALL MOUNTED PROTECTORS

- A. Category 3 Protector Fields & Modules, Stub to 110
 - 1. Drawing references:
 - a. LP110TB6 6 pair
 - b. LP110TB25 25 pair
 - c. LP110TB50 or LP50 50 pair
 - d. LP110TB100 or LP100 100 pair
 - 2. Approvals
 - a. UL Listed.

- b. RUS approved.
- 3. Features/Functions/Construction.
 - a. Accommodates Protector Modules specified herein. Coordinate selected devices to preserve UL Listing.
 - b. Wall mount enclosure, with hinged cover
 - c. Quiet front - no unprotected parts exposed to end user.
 - d. Physical layout compatible with 110 series punch blocks.
 - e. Unprotected input: Swivel Cable stub, length to suit application. Terminated in 710 Connector, 3M or equal, unless otherwise noted
- 4. Protected output: Type 110 block.
 - a. Heat Coil Resistance: 4 ohm
 - b. Performance:
 - 1) Voice Pairs:
 - a) Gas or Solid State.
 - b) Breakdown Voltage - 230 V.
 - 2) Protector Quantity:
 - a) Unless otherwise noted, protect both ends of each outside plant pair installed.
 - b) Provide 98% of protectors as Gas Tube with 4 ohm heat coils
 - c) Provide 2% of protectors as Solid State with 4 ohm heat coils.
 - d) Apply to Owner for instruction as to where to place Solid State protectors.
- 5. Manufacturer, Protector Field:
 - a. Circa 1880ECAI Series
- B. Manufacturer, Protector Module:
 - 1. Circa:
 - a. Gas Tube 3B1E
 - b. Solid State 4B1S

PART 3 EXECUTION

3.1 SURGE PROTECTION:

- A. Unless otherwise noted, all cables and conductors, except fiber optic cable, which are installed by this project to provide inter-building communication connections, shall have surge protection installed at each end which meets the requirements of REA PE-60.
- B. Termination:
 - 1. Provide protection at both ends of all pairs.
 - 2. Provide protector modules equal to the number of installed pairs – refer to the requirements for LP100 in Part 2 of this Section for the types and ratios of protectors to be provided.
- C. Locate protection as indicated on the backboard elevations on the plans.
 - 1. If protectors are not indicated on a backboard elevation, located between +24" and 7'-0" above the finished floor at the left edge of the backboard, after allowing for OSP cabling wrapping and management at the backboard edge.

- D. Refer to Section 27 13 00 Communications Indoor Backbone Cabling for requirements for termination within IDF's, and BDF's.

END OF SECTION

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SECTION 27 1116

COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Communications racks and cabinets.
- B. Communications Rack Mounted Power Protection and Power Strips

1.2 RELATED WORK IN OTHER SECTIONS

- A. Section 27 0526 – Grounding and Bonding for Communications Systems
 - 1. Bonds racks and cabinets.
- B. Section 27 0533 – Conduits and Backboxes for Communications Systems
 - 1. Signal systems raceways at communications rooms
- C. Section 27 0536 – Cable Trays for Communications Systems
 - 1. Signal systems cable tray at communications rooms
- D. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
 - 1. Installation of rack mounted power strips, protection and distribution units.
- E. Section 27 1300 – Communications Indoor Backbone Cabling
 - 1. Inside Backbone Terminations at communications rooms.
- F. Section 27 1500 Communications Horizontal Cabling
 - 1. Rack mounted horizontal patch panels.

1.3 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. EIA/ECA-310-E (2005) Cabinets, Racks, Panels, and Associated Equipment
 - 2. ANSI/TIA-607-D-2019 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- B. International Conference of Building Officials (ICBO)
 - 1. AC156 ICBO ES Acceptance Criteria for Seismic Qualification Testing of Nonstructural Components (Jul. 2004)
- C. Telecordia Technologies
 - 1. Network Equipment Building System (NEBS) GR-63-CORE (Seismic Zone 4)

1.4 SUBMITTALS

- A. Conform with the requirements of Section 27 0500 - Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance Section 27 1000 – Structured Cabling, Basic Materials and Methods.

PART 2 PRODUCTS

2.1 GENERAL

A. KEYS

1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically.

2.2 EQUIPMENT ENCLOSURE SYSTEMS

A. General:

1. Provide enclosure systems including, but not limited to enclosures, cabinets, cases and related panels and accessories as specified herein. Provide size and quantity as shown on drawings or scheduled.
2. Provide color as shown on drawings. If no color is shown on drawings, submit manufacturer's standard color chips for selection.
3. Provide enclosure systems conforming to the CBC, latest edition, for seismic design.
4. Equipment Enclosures: Each rack provided with frame angles tapped 10-32, ANSI/EIA 310-D Universal Spaced.

B. Relay Rack, Integrated Vertical Wire Chase, Zone 4 rated

1. Drawing Reference(s)
 - a. R15
2. Construction
 - a. Zone 4 listed assembly meets Zone 4 requirements with a least a 500 pound uniformly distributed load.
 - b. Two wide vertical side channels tapped with EIA mounting holes on both sides, 6" deep section construction minimum.
 - c. Full 19" wide EIA Frame fits standard equipment forms – assemblies with non-standard opening widths not permitted.
 - d. Overall width shall be no more than 25".
 - e. Floor mount plates
 - f. Top angle or plate.
 - g. Front and back vertical wire management troughs on both sides of rack, unless otherwise indicated on plans - 12" Wide and x 12" minimum depth vertical cross-section, each trough (24" overall depth). Removable horizontal strips or braces at 12" o.c. vertical restrain cabling within trough.
 - 1) Install with flexible service cord and cord cap near top of vertical panel opening.
 - h. 44 EIA Rack Units minimum.
 - i. Provide fifty (50) 12-24 and fifty (50) 10-32 rack mounting screws per rack.
3. Manufacturers, Zone 4 rated assembly - subject to minimum panel opening criteria scheduled above:
 - a. CPI Seismic Frame Two Post Rack with CPI Evolution G2, 12" wide, 7' high, Double-Sided Vertical Cable Manager 35524-703.
 - b. B-Line Advantage Seismic Relay Rack SB-852-19-084 FB with CPI Evolution G2, 12" wide, 7' high, Double-Sided Vertical Cable Manager 35524-703.
 - c. or equal.

2.3 RACK PANELS AND ACCESSORIES

A. Rack Mounting Screws:

1. Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive. Slotted screws are not acceptable.

B. Vertical Lacer Strips

1. 44RU high vertical steel strips with points for attachment of velco cable ties at at least 6" o.c.
2. Manufacturer:
 - a. Middle Atlantic LACE-44LP
 - b. APW
 - c. or equal.

C. Horizontal Lacer Bars

1. EIA 19" Width steel strips or bars suitable to provide support to large cable dressed horizontally through racks
2. Size to suit load and mounting width.
3. Manufacturer:
 - a. Middle Atlantic LBP-1R4, LBP-1.5 and LBP-1S.
 - b. APW
 - c. or equal.

PART 3 EXECUTION

3.1 MOUNTING

- A. Unless otherwise noted, all floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.
- B. Rows of identical racks shall be bolted together, in addition to being bolted to the floor, and bonded to form a single electrical ground plane.
- C. Wall mounted equipment racks and cabinets shall similarly be bolted to structural members in accordance with the requirements of the CBC and the contractors approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

3.2 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

- A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.
- B. Provide permanent labels for all equipment and devices.
- C. Floor racks to be bolted floor unless otherwise indicated.

- D. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- E. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.
- F. Where wiring of mixed types are called for on the plans, maintain separation of wiring classifications as specified in the individual sections of the Communications Work. Separately dress, route and land microphone, audio line level and data cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level, data and control cables on the left side of the equipment enclosure, as viewed from the rear.
- G. Provide vertical wire management of cabling within the rack independent of the adjustable EIA mounting rails. Vertical wiring management provided by the contractor within the rack shall not prevent such rails from being moved as required by the Owner.
- H. Dress and support cabling at a minimum of 24 inch on center.
- I. Access shall not require demounting or de-energizing of equipment or cabling. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- J. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.
- K. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

3.3 SIGNAL GROUNDING & BONDING PROCEDURES

- A. Comply with National Electrical Code and the California Electric Code. Bond equipment racks to ground in accordance with the California Electric Code and ANSI/ EIA/ TIA 607 and Section 27 05 26
- B. Unless otherwise noted maintain a unipoint ground scheme.
- C. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

END OF SECTION

SECTION 27 1119

COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section defines material standards for:
 - 1. Copper Termination Assemblies, including
 - a. Rack and cabinet mounted copper patch panels
 - b. Backboard, rack and cabinet mounted terminal blocks
 - 2. Fiber Termination Assemblies, including:
 - a. Fiber connectors
 - b. Rack and cabinet mounted fiber patch panels

1.2 RELATED WORK UNDER OTHER SECTIONS

- A. Section 27 0500 – Common Work Results for Communications
- B. Section 27 0526 – Grounding and Bonding for Communications Systems
- C. Section 27 1000 – Structured Cabling, Basic Materials and Methods
- D. Section 27 1113 – Communications Entrance Protection
- E. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- F. Section 27 1123 – Communications Cable Management
- G. Section 27 1300 – Communications Indoor Backbone Cabling
- H. Section 27 1500 – Communications Horizontal Cabling

1.3 REFERENCES:

- A. ELECTRONIC INDUSTRIES ALLIANCE (EIA)
 - 1. EIA/ECA-310-E (2005) Cabinets, Racks, Panels, and Associated Equipment

1.4 SUBMITTALS

- A. Conform with the requirements of Section 27 0500 - Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 27 1000 – Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 COPPER CABLE TERMINATION DEVICES AND RELATED

- A. Data Patch Panels, Category 6A Rated, Rack Mounted

1. Drawing References:
 - a. ***C6APP, where *** refers to port count.
2. Dimensions:
 - a. Depth, with cable management 10.50 in
 - b. Diameter Over Dielectric, maximum 0.046 in
 - c. Diameter Over Dielectric, minimum 0.030 in
 - d. Height 3.50 in
 - e. Width 19.00 in
3. Electrical Specifications
 - a. ANSI/TIA Category 6A
 - b. Current Rating 1.5 A @ 20 °C
 - c. 1.5 A @ 68 °F
 - d. Dielectric Withstand Voltage, RMS, conductive surface 1500 Vac @ 60 Hz
 - e. Dielectric Withstand Voltage, RMS, contact-to-contact 1000 Vac @ 60 Hz
 - f. Insulation Resistance, minimum 500 MOhm
4. Environmental Specifications
 - a. Flammability Rating UL 94 V-0
 - b. Operating Temperature -10 °C to +60 °C (+14 °F to +140 °F)
 - c. Relative Humidity Up to 95%, non-condensing
 - d. Safety Standard cUL, UL
 - e. Storage Temperature -40 °C to +70 °C (-40 °F to +158 °F)
 - f.
5. General Specifications
 - a. Cable Type U/UTP (unshielded)
 - b. Modules, quantity 8
 - c. Product Type Angled or Flat Panel
 - d. Total Ports, quantity 48
 - e. Color Cool gray, Satin chrome
 - f. Intelligence Type iPatch® ready
 - g. Rack Type EIA 19 in
 - h. Rack Units 2
6. Mechanical Specifications
 - a. Conductor Gauge, solid 22 AWG, 24 AWG
 - b. Conductor Gauge, stranded 22 AWG, 24 AWG
 - c. Conductor Type Solid, Stranded (7 strands)
 - d. Material Type High-impact, flame retardant, thermoplastic Powder-coated steel
 - e. Outlet/Module Contact Plating Gold over nickel
 - f. Plug Insertion Life Test Plug IEC 60603-7 compliant plug
 - g. Plug Insertion Life, minimum 750 times
 - h. Plug Retention Force, minimum 30 lbf, 133 N
 - i. Rear Termination Contact Plating Gold over nickel
 - j. Rear Termination Type IDC
 - k. Wiring Scheme T568B
7. Regulatory Compliance/Certifications
 - a. RoHS 2002/95/EC Compliant
 - b. ISO 9001: 2008. Designed, manufactured and/or distributed under this quality management system 19" EIA rack mountable.
8. Manufacturer
 - a. COMMSCOPE SYSTIMAX 360 GigaSPEED X10D 1100GS6 Evolve Angled

Category 6A UTP Patch Panel, 48 port, to be used for horizontal data and voice cabling. (District Standard).

2.2 FIBER CABLE TERMINATION DEVICES AND RELATED:

A. Fiber Optic Connectors and Related:

1. Connectors:

- a. Manufactured pigtail at rack mounted patch panels as noted or scheduled.
- b. Physical Characteristics:
 - 1) Pre-terminated connector prepared for fusion splice.
 - 2) Match the fiber cables specified under section 27 1300 and 27 1400.
- c. Application:
 - 1) SC for Data Systems
 - 2) LC for Fire Alarm Systems
- d. Color:
 - 1) Singlemode: Blue
- e. Manufacturer:
 - 1) Commscope Systimax (District Standard)
 - 2) or equal (no known equal)

2. Fusion Splice System

- a. Insertion Loss:
 - 1) ≤ 0.06 dB - manufacturer's rating for typical splice - Singlemode.
- b. Manufacturer
 - 1) Commscope Systimax (District Standard).

3. Breakout Kits:

- a. Commscope Systimax (District Standard).

B. Fiber Patch Panels

1. Drawing References: *** FPP, where *** refers to the fiber port count.

2. Features/Functions/Performance:

- a. 19" EIA rack mount
- b. Suitable for housing fiber optic mechanical splices in a neat and orderly fashion.
- c. Stores a minimum of one meter of cable without kinks or twists.
- d. Provides individual strain relief for each splice.
- e. Suitable for reentry, if required for future maintenance or modification, without damage to the cable or splices.
- f. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.
- g. Incorporates cable tie downs and routing rings.
- h. Provides a location for splice, maintenance and cross-connecting of fiber optic cables.

3. Manufacturer:

- a. Commscope Systimax HD 4U (District Standard)
 - 1) For up to 24 terminations, provide rack-mount, 2U shelf with slide-out tray, hinged door, front cable management trough and top cover.
 - a) Commscope Systimax HD-2U
 - 2) For greater than 24 terminations, provide high-density, rack-mount shelf with hinged front and rear doors, cable entry protectors, sliding splice/termination panels and blank panels.
 - a) Commscope Systimax HD-4U

PART 3 - EXECUTION

- A. Refer to Section 27 1300 Communications Indoor Backbone Cabling for requirements for termination of Riser and Outside Plant Cabling within IDF's, and BDF's.
- B. Refer to Section 27 1000 – Structured Cabling, Basic Materials and Methods and Section 27 1500 – Communications Horizontal Cabling.

END OF SECTION

SECTION 27 1123
COMMUNICATIONS CABLE MANAGEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Section includes provision of cable management for cabling installed under the work of this Project as well as patch cords at equipment racks
- B. Scope includes:
 - 1. Cable End Spillway
 - 2. Backboard Cable Management

1.2 RELATED WORK IN OTHER SECTIONS

- A. Section 27 0533 – Conduits and Backboxes for Communications Systems
- B. Section 27 0536 – Cable Trays for Communications Systems
- C. Section 27 0553 – Identification for Communications Systems
- D. Section 27 1000 – Structured Cabling, Basic Materials and Methods
- E. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- F. Section 27 1119 – Communications Termination Blocks and Patch Panels
- G. Section 27 1300 – Communications Indoor Backbone Cabling
- H. Section 27 1500 – Communications Horizontal Cabling

1.3 REFERENCES

- A. American Society For Testing and Materials (ASTM)
 - 1. ASTM D2239-03 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
- B. Underwriters Laboratories (UL)
 - 1. UL 910 Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables used in Spaces Transporting Environmental Air (Nov. 1998)

1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 3000 – Administrative Requirements and Section 27 0500 - Common Work Results for Communications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 01 6000 – Product Requirements and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

PART 2 PRODUCTS

2.1 CONDUIT CABLE MANAGEMENT

A. Conduit End Waterfall Spillway

1. Drawing Reference: CEW
2. Features/Functions
 - a. Spillway fastens to end of EMT conduit, provides radius sweep, open on top, solid from below
 - b. Maintains proper bend radii for fiber/cable
 - c. Provides tie points for fire pillow retention
 - d. Supports up to 100 lbs. of hanging fiber/cable
 - e. Clamp for securing to EMT
 - f. Self-fastening tie down system for supporting cabling
3. Construction:
 - a. Fire Retardant ABS
4. Manufacturers:
 - a. Bejed BJ-2049 Spillway.

2.2 BACKBOARD CABLE MANAGEMENT

A. Fiber Management Ring, Preformed Loop

1. Drawing Reference: FMR
2. Construction:
 - a. 24 inch diameter steel ring stores fiber slack using Velco fasteners at regular intervals around ring.
 - b. Screw fastens to backboard at BDF or IDF.
3. Manufacturer
 - a. Leviton 48900-IFR for inside plant riser fiber and Leviton 48900-OFR for outside plant fiber.
 - b. or equal (no known equal)

B. Wire Management Rings, Wall/Ceiling Mounted:

1. Drawing References/Functions Features:
 - a. WMRB - Bridle Ring Type, Threaded Lag Screw
 - b. WMRC - Closed Ring, U shaped assembly with two screw holes at ends,
 - c. WMRO - Open, Re-enterable Split Ring permitting cables to be inserted midspan, two screw holes at ends
2. Provide as required to support indicated cable bundle and location.
3. Provide type WMRB at wood frame construction for cable hung from underside of ceiling, unless otherwise noted.
4. Manufacturers:
 - a. WMRB:
 - 1) B-Line Fasteners, BR Series
 - 2) Senior Industries

- 3) T&B
- 4) or equal.
- b. WMRC
 - 1) Chatworth Products Wall Mount Closed D Ring.
 - 2) Senior Industries
 - 3) or equal.
- c. WMRO
 - 1) Chatworth Products Wall Mount Open Ring.
 - 2) AllenTel
 - 3) Systimax, Inc.
 - 4) Siemon
 - 5) or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to Section 27 1300 Communications Indoor Backbone Cabling for requirements for cable routing within IDF's, and BDF's.

3.2 CONDUIT END WATERFALL

- A. Fasten securely to conduit end wherever cabling will exit conduit 18" or more above the cable tray to prevent damage due to cabling due to weight of cable bearing on a conduit end.
- B. Secure cabling with integral cable restraint system.

END OF SECTION

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SECTION 27 1300

COMMUNICATIONS INDOOR BACKBONE CABLING

PART 1 GENERAL

1.1 SCOPE OF WORK:

A. Work of this Section includes:

1. Indoor Copper Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
2. Indoor Optical Fiber Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
3. Terminate fiber on patch panels as specified in Section 27 1119.
4. Terminate copper cabling on terminal blocks as specified in Section 27 1119. Provide terminal block, high pair count copper connector cabling and rack mounted patch panels to permit Owner's telephone contractor to cross-connect the entrance and riser cabling to individual station ports using patch cords.
5. For all cabling:
 - a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 1000.
 - b. Label cables, jacks, plates and patch panels as specified in Section 27 0553.
 - c. Document on Record Documents as described in Section 27 0500.

B. Related work in other Sections

1. Section 27 0526 – Grounding and Bonding for Communications Systems
2. Section 27 0529 – Hangers and Supports for Communications Systems
3. Section 27 0533 – Conduits and Backboxes for Communications Systems
4. Section 27 0536 – Cable Trays for Communications Systems
5. Section 27 0548 – Noise and Vibration Controls for Communications Systems
6. Section 27 0553 – Identification for Communications Systems
7. Section 27 1000 – Structured Cabling, Basic Materials and Methods
8. Section 27 1113 – Communications Entrance Protection
9. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
10. Section 27 1119 – Communications Termination Blocks and Patch Panels
11. Section 27 1123 – Communications Cable Management
12. Section 27 1126 – Communications Rack Mounted Power Protection & Power Strips
13. Section 27 1500 – Communications Horizontal Cabling

1.2 REFERENCES

- A. Refer to Section 27 1000 – Structured Cabling, Basic Materials and Methods

1.3 SUBMITTALS

- A. Conform with the requirements of Section 27 0500 - Common Work Results for Communications.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 27 1000 – Structured Cabling, Basic Materials and Methods.

PART 2 PRODUCTS

2.1 COPPER BACKBONE CABLING

A. General

1. Each conductor shall be a minimum of 22 or 24 AWG.
2. Complies with
 - a. ICEA S-90-661
 - b. EIA TIA/EIA-568-B.1
 - c. EIA TIA/EIA-568-B.2
 - d. NEMA WC 63.1
 - e. UL 444
3. Solid conductor 100 ohm multi-pair UTP (Unshielded twisted pair), formed into 25 pair binder groups covered with a gray thermoplastic jacket.
4. Imprinted with
 - a. manufacturers name or identifier,
 - b. flammability rating,
 - c. gauge of conductor,
 - d. transmission performance rating (category designation)
 - e. at regular intervals not to exceed 2 feet.
5. The word "FEET" or the abbreviation "FT" shall appear after each length marking.
6. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
7. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.
8. Color coding shall comply with industry standards for 25 pair cables.

- B. Cables: Cables which interconnect interior distribution centers shall conform to ICEA S-80-576. Where required, cable shall be UL classified low smoke and low flame for use in air plenums in accordance with NFPA 70. Cables which terminate at each station jack shall conform to ICEA S-80-576. Each cable shall be a minimum of 22 or 24 AWG.

C. Telephone, Inside Distribution Wire, Plenum Rated

1. Drawing Reference ** PR T-IDWP, where ** refers to required pair count.
2. Construction:
 - a. 4 to 100 pair count voice pair cabling in overall jacket.
 - b. NEC Type CMP.

- c. USOC color code.
- d. Nominal Outside Diameter, not to exceed the following:

Pair Count	Outside Diameter (inches)
4 pr.	0.19
25 pr.	0.47
50 pr.	0.63
100 pr.	0.84

- 3. Manufacturer:
 - a. Commscope (District Standard).

2.2 FIBER OPTIC COMMUNICATIONS CABLING AND RELATED:

A. Fiber count per cable to comply with minimum counts indicated on the plans. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

B. FIBER, SINGLEMODE - GENERAL

- 1. Meeting EIA/TIA 568
- 2. Construction:
 - a. Standards Compliance ITU-T G.652.D | ITU-T G.657.A1 | TIA-492CAAB (OS2)
 - b. Attenuation, maximum 0.22 dB/km @ 1,550 nm | 0.23 dB/km @ 1,575 nm | 0.25 dB/km @ 1,490 nm | 0.25 dB/km @ 1,625 nm | 0.31 dB/km @ 1,385 nm | 0.34 dB/km @ 1,310 nm | 0.35 dB/km @ 1,650 nm
 - c. Dispersion, maximum 18 ps(nm-km) at 1550 nm | 3.5 ps(nm-km) from 1285 nm to 1330 nm at 1310 nm
 - d. Mode Field Diameter 10.4 μm @ 1,550 nm | 9.2 μm @ 1,310 nm | 9.6 μm @ 1,385 nm
 - e. Mode Field Diameter Tolerance ±0.3 μm @ 1310 nm | ±0.5 μm @ 1550 nm | ±0.6 μm @ 1385 nm
 - f. Index of Refraction 1.467 @ 1,310 nm | 1.468 @ 1,385 nm | 1.468 @ 1,550 nm
 - g. Polarization Mode Dispersion Link Design Value, maximum 0.04 ps/sqrt(km)
 - h. Cladding Diameter 125.0 μm
 - i. Cladding Diameter Tolerance ±0.7 μm
 - j. Cladding Non-Circularity, maximum 0.7 %
 - k. Coating Diameter (Colored) 253 μm
 - l. Coating Diameter (Uncolored) 240 μm
 - m. Coating Diameter Tolerance (Colored) ±7 μm
 - n. Coating Diameter Tolerance (Uncolored) ±5 μm
 - o. Coating/Cladding Concentricity Error, maximum 12 μm
 - p. Core/Clad Offset, maximum 0.5 μm
 - q. Cabled Cutoff Wavelength, maximum 1260 nm
 - r. Point Defects, maximum 0.10 dB
 - s. Zero Dispersion Slope, maximum 0.090 ps/[km-nm-nm]
 - t. Zero Dispersion Wavelength, maximum 1322 nm
 - u. Zero Dispersion Wavelength, minimum 1302 nm

- 3. Manufacturer:
 - a. Commscope Systimax TeraSPEED OS2 Singlemode Fiber (District Standard).

C. FIBER OPTIC CABLE CONSTRUCTION, GENERAL

- 1. All Dielectric, unless otherwise noted.

2. Color Code:
 - a. Per EIA/TIA-598A.
 - b. Colors shall be across specified storage/installation temperature range.
 - c. Means of providing conforming colors shall not degrade performance of cable.
3. Jacket:
 - a. Free of splits, holes or blisters.
 - b. Marked in conformance with NEC 350G
4. Heavy duty construction, Fiberglass Epoxy Rod/Kevlar strength member(s).
5. Each fiber to be 100% attenuation tested by the Manufacturer prior to shipping to indicate conformance of shipped cable to requirements herein. Manufacturer's test to be affixed to shipping reel.
6. Performance:
 - a. Temperature Sensitivity:
 - 1) Storage: -40C° to +70C°.
 - 2) Installation: -30C° to +70C°.
 - 3) Variance:

Single Mode: Average change, not more than 0.05 dB/km at 1550 -40C° to +70C°. Maximum change not more than 0.15 dB/km at 1550 nm.

2.3 TELEPHONE CABLING CLOSURE

- A. In Building Telephone Closure:
 1. Drawing Reference: IBTC
 2. Features and Functions:
 - a. Provides transition point from unlisted, gel-filled Outside Plant Cabling to Interior (T-IDW) cabling
 - b. Can house a straight, butt, and branch splice in a protective housing.
 - c. Not pressurized or encapsulated.
 - d. Fire-retardant Plastic construction, meeting PUB55006 for interior (in-building) installation.
 - e. RUS (formerly REA) listed for application.
 - f. Provide a suitable means for mounting to backboard.
 3. Manufacturer:
 - a. 3M K&B Series
 - b. or equal by Commscope.

PART 3 EXECUTION

3.1 FIBER OPTIC CABLING PRACTICE

- A. Service Loop
 1. At IDF's and BDF's, at both ends of cables, provide at least 15 feet of fiber in excess of that required to reach the patch panel by a dressed route. Form into a storage loop and fix in place as directed by the Owner's Representative.

2. At the Telecomm Building, provide at least 20 feet of fiber in excess of that required to reach the patch panel by a dressed route. Form into a storage loop and fix in place in the cable vault (outside of the machine room) as directed by the Owner's Representative.
- B. Splicing:
1. Interior: Provide mechanical splices,.
 2. Exterior: Do not splice at exterior unless splicing is indicated on Plans. In such circumstances, provide fusion splices.
- C. Termination Methods
1. Review proposed breakout procedure with the Owner's Representative before beginning this work.
 2. Use full cable breakout method. Display both connectorized and non-connectorized fibers entering a patch panel.
 3. Remove sheath so that no more than 4 inches of unstripped cable enters the panel.
 4. Strip back a sufficient amount of cable so that fiber strands wrap at least one full wrap, circle or figure eight, inside the panel with the connectorized ends attached to the most distant bulkhead connectors.
 5. Group together the fibers from each binder group with 0.125 inch nylon spiral wrap. (Systimax, Panduit, Corning Cable Systems SAN-DT25-06, or equal.)
- D. Outside Plant
1. Obtain allowable pulling tension for underground fiber cable from the manufacturer. Use pulling equipment with tension gauges to verify that cable pulls do not exceed allowable pulling tension.
 2. Loose Tube, Gel Filled Cabling - No flow of filling when tested in accordance with FOTP-81.
- E. Loose Tube Breakout
1. Install breakout tubing over the full exposed length of the fiber strands.
 2. Install buffer tubing on all strands, including those not being connectorized as part of this Contract.
 3. Reinforce and protect the junction of the cable sheath and buffer tubing using a method approved by the Owner's Representative before beginning this work.

3.2 COPPER BACKBONE TIE CABLE INSTALLATION AND TERMINATION

- A. General:
1. Backbone cable(s) shall be installed in conduit system unless otherwise noted.
- B. Sequencing:
1. If the installation of a tie cable requires the disconnection and removal of any existing cable(s) carrying active service prior to installation
 - a. Notify the Owner's Representative no less than 5 working days in advance of when this work is to be performed.
 2. When this work is performed, the newly installed cables must be installed, tested and passed in one 24 hour period beginning when the active service on the existing cable is interrupted.
- C. Installation of Tie Cable:

1. All tie cable between terminal blocks at IDF rooms shall be continuous, unspliced runs.
2. Termination of Voice or Shared Use Tie Cable:
 - a. Cable shall be terminated on patch panels.

3.3 DATA/TELEPHONE IDF ROOM LAYOUT

A. General:

1. Final backboard design layout within an IDF room shall be approved by the Owner's Representative prior to work beginning on the backboard.
2. Reference the design basis layout in the plans and bring to the Owner's Representative's attention any field conditions that would prevent installation as shown on the plans. Submit for resolution in a timely manner.
3. Layout of cable around backboard:
4. All backbone cable shall be formed around the backboard before either rising or dropping vertically to the punch blocks on which they are to be terminated.
5. All backbone cable shall be organized in Wire Management Rings, Split D, Type WMRO. No tywraps or similar bindings are permitted.
6. Termination:
 - a. Terminate voice pairs and BDF tie cable on 110 blocks.

3.4 DATA/TELEPHONE NODE AND BDF ROOM LAYOUT

A. General:

1. Final backboard and cable runway design layout within the Telecomm Building or within a BDF room shall be approved by the Owner's Representative prior to work beginning.
2. Reference the design basis layout in the plans and bring to the Owner's Representative's attention any field conditions that would prevent installation as shown on the plans. Submit for resolution in a timely manner.

B. Layout of cable around backboard:

1. All cables shall be formed around the backboard before either rising or dropping vertically to the punch blocks on which they are to be terminated.
2. All cables shall be organized in Wire Management Rings, Split D, Type WMRO.. No tywraps or similar bindings are permitted.

C. For outside plant, flooded cables entering the Telecomm Building, a BDF or an IDF functioning as a building entrance facility,

1. Transition in a splice case to non-flooded cable prior to termination on protector blocks for voice pairs, or on an unprotected 110 block for systems pairs, where such are indicated. Where systems pairs are not indicated, assume all pairs are for voice use.
2. Position the splice case on the backboard where accessible for future service. Orient parallel to floor to prevent continuous gel flow from OSP cabling. Place on cable tray only where such placement is indicated on the plans.

END OF SECTION

SECTION 27 1400
COMMUNICATIONS OUTSIDE PLANT BACKBONE CABLING

PART 1 GENERAL

1.1 SCOPE OF WORK:

A. Work of this Section includes:

1. Outdoor (Outside Plant) Communications Cabling placed underground in new and existing communications ducts between the MDF and IDF's of this Project selected pedestal locations, including:
 - a. High pair count copper cabling
 - b. Fiber Optic Cabling
2. Terminate fiber on patch panels as specified in Section 27 1119.
3. Terminate copper cabling on lightning protectors as specified in Section 27 1113.
4. For all cabling:
 - a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 1000.
 - b. Label cables, jacks, plates and patch panels as specified in Section 27 0553.
 - c. Document on Record Documents as described in Section 27 0500.

B. Related work in other Sections

1. Section 27 0526 – Grounding and Bonding for Communications Systems
2. Section 27 0529 – Hangers and Supports for Communications Systems
3. Section 27 0533 – Conduits and Backboxes for Communications Systems
4. Section 27 0536 – Cable Trays for Communications Systems
5. Section 27 0543 – Underground Ducts and Raceways for Communications Systems
6. Section 27 0548 – Noise and Vibration Controls for Communications Systems
7. Section 27 0553 – Identification for Communications Systems
8. Section 27 1000 – Structured Cabling, Basic Materials and Methods
9. Section 27 1113 – Communications Entrance Protection
10. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
11. Section 27 1119 – Communications Termination Blocks and Patch Panels
12. Section 27 1123 – Communications Cable Management
13. Section 27 1300 – Communications Interior Backbone Cabling
14. Section 27 1500 – Communications Horizontal Cabling

1.2 REFERENCES

- A. Usage: In accordance with Division 1.

- B. In addition to the requirements of Section 27 0500 - Common Work Results for Communications Systems and 27 1000 - Structured Cabling, conform to the applicable portions of the following standards agencies:

1. BICSI
 - a. Customer Owned Outside Plant Design Manual, 6th Edition
2. Insulated Cable Engineers Association (ICEA)
 - a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.
3. Underwriters Laboratories, Inc. (UL)
 - a. UL 497 (1995, R 2001) Safety (Dec. 15, 1978, 4th Ed.; Rev. thru Oct. 9, 1990) Protectors for Communications Circuits
4. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA):
 - a. RUS/REA Bulletin (Jan. 1993; Supp 1 thru 7) 1755I-100 List of Materials Acceptable for Use on Telephone System of REA Borrowers.
 - b. RUS (REA) PC-2 (Jan. 1978) Splicing Standard.
 - c. RUS (REA) PC-4 (July 1976) Acceptance Tests and Measurements of Telephone Plant.
 - d. RUS (REA) PE-22 (No. 1982) Aerial and Underground Telephone Cable.
 - e. RUS (REA) PE-33 (Mar. 1985) Shield Bonding Connectors.
 - f. RUS (REA) PE-39 (June 1993) Filled Telephone Cables.
 - g. RUS (REA) PE-60 (Sep. 1979) Trunk Carrier Systems.
 - h. RUS (REA) PE-74 (Oct. 1985) Filled Splice Closures.
 - i. RUS (REA) PE-87 (Dec. 1983) Terminating (TIP) Cable.
 - j. RUS (REA) PE-89 (June 1993) Filled Telephone Cable with Expanded Insulation.
 - k. RUS (REA) TECM 644 (Apr. 1983; Issue No.3) Design and Construction of Underground Cable (Physical Plant).
 - l. RUS (REA) TECM 823 (Aug. 1980; Issue No. 3) Electrical Protection by Use of Gas Tube Arrestors.
 - m. SUBMITTALS

- C. Conform with the requirements of Division 1 and Section 27 0500 - Common Work Results for Communications Systems.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Division 1 and Section 27 1000 – Structured Cabling, Basic Materials and Methods.

PART 2 PRODUCTS

2.1 FIBER OPTIC CABLING

- A. Fiber Optic Cable, Outside Plant:

1. Drawing References:
 - a. XX FOS-OP Singlemode, where XX indicates fiber count.
2. Fiber: Refer to:
 - a. FIBER, SINGLE MODE, GENERAL, as specified under section 27 1300.
3. Application: Inter-building site distribution in manholes and site conduit. Conform to NEC and CEC limits on placement within building envelope.

4. Listing: NEC OFN, Listing by nationally recognized testing agency.
5. Construction:
 - a. Refer additionally to Fiber Cable Construction, General, elsewhere herein.
 - b. Suitable and Code approved for wet location/direct burial
 - c. Provide Loose Tube Gel Filled Construction Water Blocking Construction.
 - i. Loose Tube, Gel Filled Construction Option.
 - (1) Tubes:
 - (a) Up to 12 fibers per tube.
 - (b) Multiple fibers per tube.
 - (c) Kink resistant construction within bend radius specified.
 - (2) Gel:
 - (a) Inorganic, non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel.
 - (b) Free from dirt and/or foreign matter.
 - (c) Readily removable with non-toxic solvents.
 - (3) Overall Construction.
 - (a) Inorganic, non-hygroscopic binder fill provided to supplement and support uniform cable construction as required.
 - (b) Buffer tubes stranded around central support member using "S-Z" process, left hand lay.
 - (c) Binders to be applied with sufficient tension to secure buffer tubes to the central member without crushing buffer tubes.
 - (d) High tensile strength dielectric yarns helically woven around cable core to provide tensile strength.
 - (e) Zero flow of filling/gel per FOTP-81.
 - d. Jacket:
 - i. Polyethylene, polyurethane or PVC.
 - ii. 0.040" minimum thickness.
 - e. Maximum Cable Diameter:
 - i. 4 to 48 Fibers: 0.46"
 - ii. 72 Fibers: 0.50"
 - iii. 96 Fibers: 0.58"
 - iv. 144 Fibers: 0.74"
 - v. 288 Fibers: 0.86"
6. Performance:
 - a. Maximum attenuation
 - i. Singlemode
 - (1) 1300 nm: 0.7 dB/km
 - (2) 1550 nm: 0.7 dB/km
 - b. Maximum required bend radius:
 - i. At installation: 20x's diameter
 - ii. Long term application: 10x's diameter
 - c. Zero water entry per FOTP-82, 24 hours immersion.
 - d. Minimum Safe Longitudinal Load:
 - i. At installation,
 - (1) 1 Fiber: 300 lbs.
 - (2) 2 or more Fibers: 600 lbs.
 - ii. Long term application:
 - (1) 1 Fiber: 40 lbs.
 - (2) 2-3 Fibers: 80 lbs.

- (3) 4 or more Fibers: 180 lbs.
- e. Crush resistance: 600N/cm min per EIA-455-41.
- f. Impact Resistance: 25 impacts, per FOTP-25
- g. Flex, Twist/Bend: 25 cycles, per FOTP-104 and FOTP-85.
- 7. Manufacturer
 - a. Loose Tube:
 - i. Systemax TeraSpeed Singlemode Loose Tube Cable (District Standard).

2.2 COPPER OSP CABLING

- A. Telephone, Outside Plant, Underground in Ductbank
 - 1. Drawing Reference: T-OPD, with pair counts as indicated.
 - 2. Features/Functions:
 - a. Solid round copper wire.
 - b. Solid aluminum tape overall shield.
 - c. Gel filled.
 - d. Polyethylene Overall Jacket.
 - e. Suitable for direct burial.
 - 3. Manufacturer:
 - a. Alcatel
 - b. Superior/Essex
 - c. General Cable
 - d. NORDX/CDT
 - e. Any meeting REA PE-39 for cable smaller than 400 pair,
 - f. Any meeting REA PE-39 or REA PE-89 for cable 400 pair or larger.
 - g. or equal.
- B. Shield Connectors:
 - 1. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire.
 - 2. The connector shall be made of tin-plated tempered brass.
 - 3. Shield bond connectors shall comply with REA PE-33.
- C. Grounding Braid:
 - 1. Grounding braid shall provide low electrical impedance connections for dependable shield bonding.
 - 2. The braid shall be made from flat tin-plated copper.

2.3 MISCELLANEOUS UNDERGROUND PRODUCTS

- A. Pull Rope
 - 1. 1/4 inch diameter polyethylene.
 - 2. 200 pound strength.
 - 3. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Vikimatic

- c. or equal.
- B. Length Marked Tape
 1. Provide 1/2 inch flat tape with sequential markings in whole feet.
 2. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Greenlee
 - c. Vikimatic
 - d. or equal.
- C. Conduit Plugs
 1. Provide universal blank duct plug type, with eye for tying rope and tape.
 2. Manufacturers:
 - a. Carlon Telecom Systems.
 - b. Condux International, Inc.
 - c. or equal.
- D. Bonding Ribbon:
 1. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.
 2. Manufacturer:
 - a. Inwesco 12A55
 - b. Corning Cable Systems
 - c. Preformed Line Products.
 - d. or equal.
- E. Bonding Ribbon Clamp:
 1. Soft lead
 2. 1/16 inch thick
 3. Bolt hole for attachment
 4. Manufacturer:
 - a. Inwesco 12A56
 - b. Corning Cable Systems
 - c. Preformed Line Products.
 - d. or equal.
- F. Fargo Clamp:
 1. Cast copper, silver plated, furnished with copper bolt.
 2. RUS Listed
 3. Manufacturer:
 - a. Allied Bolt
 - b. Inwesco 12A57
 - c. Corning Cable Systems
 - d. or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.
- B. Provide traffic control in accordance with the requirements of Division 1.
- C. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the Owner's Representative with contractor maintained logs of air samples taken at most two hours apart.
- D. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with a appropriate means of obtaining assistance.
- E. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.
- F. Install a 3/8" nylon pullrope with all underground cables.

3.2 CABLE PULLING.

- A. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.
- B. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.
- C. Use flexible cable feeds to convey cables through manhole opening and into duct runs.
- D. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.
- E. Maintain minimum allowable bending radii in forming such loops.
- F. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into outdoor pedestals or other enclosures.
- G. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.
- H. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.3 CABLES IN MANHOLES, PULL BOXES AND HANDHOLES.

- A. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.
- B. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.
- C. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.

- D. Support cable splices in underground structures by racks on each side of the splice.
- E. Located splices to prevent cyclic bending in the spliced sheath.
- F. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.

3.4 SERVICE LOOP AT BUILDING ENTRY

- A. At IDF's and BDF's, at both ends of cables, provide at least 20 feet of cable in excess of that required to reach the protectors by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the Owner's Representative.
- B. For the copper cables, the cables terminate on the protectors and extended to rack-mounted cat 6A patch panels.
- C. Refer to Section 27 13 00 Communications Indoor Backbone Cabling for additional requirements for termination within IDF's, BDF's and Telecommunication Building.

END OF SECTION

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SECTION 27 1500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes, but is not necessarily limited to provision of:
 - 1. Horizontal Station Cabling
 - a. Horizontal copper station cabling, meeting EIA/TIA Category 6A standards, homerun from receptacles to indicated IDF or BDF. Terminated on rack mounted patch panels, as indicated.
 - 2. For all cabling:
 - a. Terminate on patch panels as specified in Section 27 1119 – Communications Termination Blocks and Patch Panels.
 - b. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 1000 - Structured Cabling – Basic Materials & Methods.
 - c. Label cables, jacks, plates and patch panels as specified in Section 27 0553 – Identification for Communications Systems.
 - d. Document on Record Documents as described in Section 27 0500 – Common Work Results for Communications.
- B. Related Documents:
 - 1. Specification Section 27 0500 – Common Work Results for Communications applies to this Section.
- C. Related Work in Other Sections:
 - 1. Section 27 0529 – Hangers and Supports for Communications Systems
 - a. J-hooks and hangers for the work of this Section
 - 2. Section 27 0533 – Conduits and Backboxes for Communications Systems
 - a. Empty raceway for the work of this Section.
 - 3. Section 27 0536 – Cable Trays for Communications Systems
 - a. Empty tray for the work of this Section.
 - 4. Section 27 0553 – Identification for Communications Systems
 - a. Labeling systems and execution for the work of this Section.
 - 5. Section 27 1119 – Communications Termination Blocks and Patch Panels
 - a. Specification for patch panels and blocks used by work of this Section
 - 6. Section 27 1123 – Communications Cable Management
 - a. Specification for innerduct, backboard and patch cord management used by the work of this Section.

1.2 REFERENCES

- A. As listed in Section 27 1000 – Structured Cabling – Basic Materials & Methods.

1.3 SUBMITTALS

- A. Conform with the requirements of Section 27 0500 - Common Work Results for Communications.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 27 1000 – Structured Cabling, Basic Materials and Methods.

PART 2 PRODUCTS

2.1 COPPER CABLING, CATEGORY RATED DATA/VOICE:

- A. High Speed, Category 6A Cabling, Plenum Rated
 - 1. Drawing Reference: ** UTP6A-4P, where ** denotes cable count
 - 2. Construction Materials
 - a. Conductor Material Bare copper
 - b. Insulation Material Polyolefin
 - c. Jacket Material Low Smoke PVC
 - d. Separator Material FEP
 - e. Separator 2 Material FEP
 - f. Diameter Over Jacket 0.265 in
 - g. Jacket Thickness 0.016 in
 - 3. Electrical Specifications
 - a. ANSI/TIA Category 6A
 - b. dc Resistance Unbalance, maximum 4 %
 - c. dc Resistance, maximum 8.00 ohms/100 m
 - d. Mutual Capacitance 6.0 nF/100 m @ 1 kHz
 - e. Nominal Velocity of Propagation (NVP) 70 %
 - f. Operating Frequency, maximum 500 MHz
 - g. Operating Voltage, maximum 80 V
 - h. Transmission Standards ANSI/TIA-568-C.2 ISO/IEC 11801 Class EA
 - i. Dielectric Strength, minimum 1500 Vac, 2500 Vdc
 - 4. Environmental Specifications
 - a. Environmental Space Plenum
 - b. Flame Test Method CMP
 - c. Installation Temperature 0 °C to +60 °C (+32 °F to +140 °F)
 - d. Operating Temperature -20 °C to +75 °C (-4 °F to +167 °F)
 - e. Cable Type U/UTP (unshielded)
 - f. Pairs, quantity 4
 - g. Jacket Color
 - 1) Data: Blue
 - 2) Voice: White
 - h. Conductor Gauge, singles 23 AWG
 - i. Conductor Type, singles Solid
 - j. Conductors, quantity 8
 - k. Separator Type Isolator
 - l. Packaging Type Reel
 - m. Pulling Tension, maximum 11 kg | 25 lb
 - 5. Agency Classification
 - a. RoHS 2002/95/EC Compliant
 - b. ISO 9001:2008 Designed, manufactured and/or distributed under this quality

management system

6. Manufacturer:
 - a. Commscope Systimax GigaSPEED X10D 2091B Plenum (District Standard).

B. Indoor/Outdoor Category 6A Plenum, Outdoor Rated Cable

1. Drawing Reference: ** UTP6-4OP, where ** denotes cable count
2. Construction Materials
 - a. Jacket Material PVDF
 - b. Conductor Material Bare copper
 - c. Insulation Material FEP
 - d. Separator Material FEP
3. Electrical Specifications
 - a. dc Resistance Unbalance, maximum 4 %
 - b. dc Resistance, maximum 8.00 ohms/100 m
 - c. Delay Skew, maximum 45 ns
 - d. Mutual Capacitance 5.6 nF/100 m @ 1 kHz
 - e. Nominal Velocity of Propagation (NVP) 70 %
 - f. Operating Frequency, maximum 500 MHz
 - g. Transmission Standards ANSI/TIA-568-C.2
 - h. Safety Voltage Rating 300 V
 - i. Dielectric Strength, minimum 1500 Vac | 2500 Vdc
4. Environmental Specifications
 - a. Environmental Space Outdoor | Plenum | Sunlight resistant
 - b. Smoke Test Method CMP
 - c. Flame Test Method CMP | NEC Article 800 | NFPA 262 | UL 444 | UL 910
 - d. Installation Temperature -25 °C to +75 °C (-13 °F to +167 °F)
 - e. Operating Temperature -40 °C to +75 °C (-40 °F to +167 °F)
5. General Specifications
 - a. Cable Type U/UTP (unshielded)
 - b. Pairs, quantity 4
 - c. Jacket Color Black
 - d. Conductor Gauge, singles 23 AWG
 - e. Conductor Type, singles Solid
 - f. Conductors, quantity 8
 - g. Separator Type Isolator
 - h. Packaging Type Reel
6. Mechanical Specifications
 - a. Pulling Tension, maximum 25 lb
7. Manufacturer:
 - a. Commscope Systimax CS44P-IO Indoor/Outdoor Category 6A, plenum, outdoor rated (District Standard).

2.2 DATA & VOICE STATION JACKS & RECEPTACLES

A. Category 6A Data Jacks Performance Requirements, General

1. Dimensions:
 - a. Depth 1.20 in
 - b. Height 0.80 in

- c. Width 0.80 in
- 2. Electrical Specifications
 - a. ANSI/TIA Category 6A
 - b. Contact Resistance Variation, maximum 20 mOhm
 - c. Contact Resistance, maximum 100 mOhm
 - d. Current Rating 1.5 A @ 20 °C
 - e. 1.5 A @ 68 °F
 - f. Dielectric Withstand Voltage, RMS, conductive surface 1500 Vac @ 60 Hz
 - g. Dielectric Withstand Voltage, RMS, contact-to-contact 1000 Vac @ 60 Hz
 - h. Insulation Resistance, minimum 500 MOhm
- 3. Environmental Specifications
 - a. Flammability Rating UL 94 V-0
 - b. Operating Temperature -10 °C to +60 °C (+14 °F to +140 °F)
 - c. Relative Humidity Up to 95%, non-condensing
 - d. Safety Standard cUL | UL
 - e. Storage Temperature -40 °C to +70 °C (-40 °F to +158 °F)
- 4. General Specifications
 - a. Cable Type U/UTP (unshielded)
 - b. Color
 - 1) Data: Blue
 - 2) Voice: White
- 5. Mechanical Specifications
 - a. Conductor Gauge, solid 22 AWG, 24 AWG, 26 AWG
 - b. Conductor Gauge, stranded 22 AWG, 24 AWG
 - c. Conductor Type Solid, Stranded (7 strands)
 - d. Material Type Copper alloy, High-impact, flame retardant, thermoplastic
 - e. Outlet/Module Contact Plating Gold over nickel
 - f. Plug Insertion Life Test Plug IEC 60603-7 compliant plug
 - g. Plug Insertion Life, minimum 750 times
 - h. Plug Retention Force, minimum 30 lbf, 133 N
 - i. Rear Termination Contact Plating Gold over nickel
 - j. Rear Termination Type IDC
 - k. Wiring Scheme T568B
- 6. Regulatory Compliance/Certifications
 - a. RoHS 2002/95/EC Compliant
 - b. ISO 9001: 2008. Designed, manufactured and/or distributed under this quality management system
- 7. Manufacturers - Category 6A jacks
 - a. Systimax 360 GigaSPEED X10D MGS600 (District Standard).
- 8. Manufacturers - Blank Module.
 - a. Systimax M20AP Covers (District Standard).
- B. Telecommunications Outlets, New, Copper Jacks, Wall Mount, Flush
 - 1. Drawing Reference: MMP4
 - 2. Assembly. Provide complete telecommunications outlet assembly, including but not limited to:
 - a. Faceplate with District standard openings
 - b. Blank connector modules at faceplate openings not filled with connector modules.
 - c. Labels and label holders.

3. Construction
 - a. Plastic - Color to match surrounding electrical plates in room.
 4. Faceplate.
 - a. Features.
 - 1) Single gang.
 - 2) Openings for up to 4 jack connector modules MMP4.
 - 3) Label holders with space to label the plate number and the number of each jack.
 5. Manufacturer:
 - a. Commscope Systimax L (District Standard).
- C. Voice Telephone, Station Plates & Jack/receptacles:
1. Drawing References:
 - a. Wall Mounted Telephone, Flush: 630A
 2. Station jacks shall be modular four wire type and conform to FCC Part 68.
 3. Construction, where not otherwise specified, scheduled or indicated:
 - a. Single Gang Wall Plate with two integral wall telephone mounting studs.
 - b. Modular jack as specified above. Provides 4 pairs to end device.
 - c. Mechanically fastened to Building. Adhesive fastening not acceptable
 - d. Stainless Steel Plate.
 - e. Mounts to Single Gang Ring, Single Gang Box or Surface Mounted to Wall or to opening in Surface Raceway - Refer to Schedule on Plans.
 - f. Jack is flush in plate and does not protrude.
 4. Manufacturers, Flush Wall Mounted Wall Telephone.
 - a. Systimax M10AW (District Standard).
- D. Patch Cords
1. Data Patch Cords – 50 light blue 5' slim type per data patch panel and one 14' light blue slim type per station jack (category 6A).
 2. Voice Patch Cords – 50 white 5' slim type (category 6A).
 3. Manufacturers:
 - a. Commscope MiNo6A Cat 6A Small Diameter Patch Cord.
 4. Fiber Patch Cords
 - a. Quantity for each BDF and IDF rooms
 - 1) Six (6) 10 feet SC-LC yellow Teraspeed patch cords.
 - b. Quantity for Fire Alarm panel
 - 1) Ten (10) 1 meter LC-LC and eight (8) 3 meter LC-LC Teraspeed duplex patch cords. Color - Red.
- 2.3 Powered Fiber Cable System
- A. Features:
1. Provides dc power alongside optical fiber signals in one hybrid cable.
 - a. Up to 12 optical fibers SMF or MMF

- b. 12 AWG or 16 AWG conductors
2. Up to 32 devices simultaneously from one power supply
3. Extends PoE distance up to 3km
4. Manufacturer:
 - a. Commscope
 - 1) Hybrid Cable
 - a) Singlemode, 4F, outdoor, 12AWG (Part Number PFC-S04O12)
 - 2) Power Supply
 - a) Power Express Distribution module supports max. 8 Devices (Part Number PFP-PX-8M)
 - 3) POE Extender
 - a) 60W, 2 Port PoE Extender (Part Number PFU-P-C-O-060-02)

PART 3 EXECUTION

3.1 SIGNAL POLARITY AND COLOR CODE CONVENTION

- A. Prepare with Category 6A Station Wire, RJ45 - Per EIA/TIA-568, designation T568B.

3.2 STATION CABLE INSTALLATION AND TERMINATION PROCEDURES

A. General:

1. All station cable, between the station outlets and the IDF terminal blocks, shall be continuous unspliced runs.
2. Station cable shall run loose throughout all pathways. At no time shall any station cable be secured by a tywrap, electrical tape or similar bindings. If bundling for directional change, plenum rated Velcro shall be used.

B. Run Lengths:

1. Station, Horizontal and IDF Links:
 - a. Horizontal Distribution runs (including vertical portions) shall not exceed 295 feet from station outlet to the associated communications closet.
 - b. IDF room distribution wiring not to exceed 19.5 feet
 - c. Alternately, total length not to exceed 328 feet.
 - d. Report to the Owner's Representative conditions exceeding these requirements.
2. Limit cable bends to a minimum radius of 8 times cable diameter except where otherwise noted herein.
3. Service loop at Station
 - a. Copper. Provide ten feet (10') service loop at each station and fifteen feet (15') for Wireless Access Point (WAP), suspended on a J-hook directly above the outlet. This is to allow the Modular Communications Unit to be removed from the outlet box and visually inspected without leaving so much wire in the box that it might become accidentally damaged during installation. Contractor to field verify the performance of the proposed installation in a mockup using the proposed cabling, jacks, raceway and listed test equipment prior to proceeding.

- b. Fiber Station Cabling. Provide 10 feet of slack fiber storage at the station, neatly coiled on the fiber management provided within the FMP enclosure, at least 12 inches at OMP.
- 4. Termination of wiring at the station outlet:
 - a. All data and voice station cable shall be terminated at the individual receptacle modules in accordance with EIA/TIA-568-B, assignment T568B.
 - b. Termination of wiring at existing station outlets:
 - 1) Install in data and voice inserts in place of existing blank insert in existing faceplate.
 - 2) Install new labels and label holders.
- 5. Termination of station wiring at the IDF
 - a. For the installation/layout of station cable within the IDF rooms, see detail on drawings.
 - b. All Category 6A station cables entering the IDF room will be terminated on a Category 6A RJ45 jack mounted in a Patch Panel as specified in Section 27 11 19 – Communications Termination Blocks and Patch Panels.
 - c. Fiber station cabling will similarly be terminated on rack mounted patch panels.
 - d. Termination shall begin at the upper left corner of the patch panel and proceed to the right continuing down, left to right until all cables are terminated.

END OF SECTION

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SECTION 27 4116

INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, set up, and testing of the Sound and Audiovisual System work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, working systems.
- B. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Section. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

1.2 SYSTEM FUNCTIONS

- A. Provide the following, in addition to work shown on the drawings and specified in Parts 2 and 3 below:
- B. Loudspeaker Processing, typical
 - 1. Program audio content to output through front of room loudspeakers/surround sound loudspeakers.
 - 2. Speech reinforcement audio content to output through overhead ceiling loudspeakers.
 - 3. At rear of spaces, blend slight amount of program audio to ceiling loudspeakers.
 - 4. For spaces over 25' deep with overhead speech reinforcement loudspeakers, provide audio delay as required so that direct acoustical source energy arrives to the listener at the same time as the reinforced overheard audio.
- C. Equipment Racks, typical
 - 1. Provide blank plates at all unused openings.
 - 2. Provide fans as required to keep the interior of each equipment rack at a temperature of no more than 5-10 degrees cooler than equipment manufacturer's recommended operating temperature.
 - a. Fans to not emit more noise than 30 dB.
 - 3. Mount equipment using T-25 Security rack screws.
- D. Single Display Classrooms w/ Voice Lift/Speech Reinforcement
 - 1. Projector (where occurs)
 - a. Provide fans as required to exhaust hot air from projector mounting area at a temperature of no more than 10 degrees cooler than projector manufacturer's recommended operating temperature.
 - 1) Fans to not emit more noise than 30 dB.
 - 2. Control: Confirm all control functions and layouts with District's Representative prior to

system programming.

- a. Touchpanel shall default to a basic mode with a button that enables advanced mode.
- b. General: Functions to operate by scene/mode, not by device.
 - 1) End user selection of an A/V input automates:
 - a) Projection screen lowers
 - b) Projector turns on, presets recalled
 - c) Sets audio chain
 - 2) End user selection on an Audio Only input automates:
 - a) Sets audio chain
 - 3) Control Button Selections
 - a) PC
 - b) Doc Cam
 - c) Laptop
 - d) HDMI
 - e) Volume Up
 - f) Volume Down
 - g) Mic Up
 - h) Mic Down
 - i) Off
 - 4) Provide graphic indication of volume level on control touchpanel.
 - 5) Provide audio and video mute selections on control touchpanel.
 - 6) Provide (independent) screen raise/lower option on control touchpanel

1.3 REFERENCE STANDARDS

- A. Conform to the applicable portions of the current standards published by these organizations:
 1. SMPTE Society of Motion Picture and Television Engineers.
 2. NAB National Association of Broadcasters.
 3. EIA Electrical Industries Association of America.
 4. UL Underwriters Laboratories.
 5. AES Audio Engineering Society.
 6. NEC National Electrical Code.
 7. NFPA National Fire Protection Association.
 8. EIAJ Electrical Industries Association of Japan.
 9. IEC International Electrotechnical Commission.
 10. FCC Federal Communications Commission.
 11. NTC Network Transmission Committee of the Video Transmission Engineering Advisory Committee.
 12. NCTA National Cable Television Association.

13. BTSC Broadcast Television Stereo Committee.
 14. TASO Television Allocation Study Organization.
- B. Conform additionally to the following specific standards:
1. American National Standards Institute (ANSI)
 - a. ANSI S1.4-1983 (R2001) American National Standard Specification for Sound Level Meters
 - b. ANSI S1.11-1986 (R2001) American National Standard Specification for Octave-Band and Fractional Octave-Band Analog and Digital Filters
 - c. ANSI S1.42-1986 (R2001) American National Standard Design Response of Weighting Networks for Acoustical Measurements
 - d. ANSI IT 7.214-89 Audio-visual Systems - Front Projection Screens (Tripod/Free-Standing) - Methods for Testing and Reporting Performance Characteristics.
 2. Audio Engineering Society Incorporated (AES)
 - a. AES2-1984 (r1997) AES Recommended Practice Specification of Loudspeaker Components Used in Professional Audio and Sound Reinforcement
 - b. AES5-1998 (Revision of AES5-1984) AER recommended practice for professional digital audio – Preferred sampling frequencies for applications employing pulse-code modulation
 - c. AES14-1992 (r1998) AES standard for professional audio equipment – Application of connectors, part 1, XLR-type polarity and gender
 - d. AES20-1996 AES recommended practice for professional audio – Subjective evaluation of loudspeakers
 - e. AES26-2001 Revision of AES26-1995 AES recommended practice for professional audio interconnections – Conservation of the polarity of audio signals
 - f. AES-R2-1998 AES project report for articles on professional audio and for equipment specifications – Notations for expressing levels
 3. Electronic Industries Association of America (EIA)
 - a. EIA-160 Sound Systems
 - b. EIA-310-E Racks, Panels and Associated Equipment
 - c. EIA-101-A Amplifiers for Sound Equipment
 - d. SE-103 Speakers for Sound Equipment
 - e. SE-104 Engineering Specifications for Amplifiers for Sound Equipment
 4. International Electrotechnical Commission (IEC)
 - a. IEC 268-3 (1988) Sound system equipment – Part 3: Amplifiers
 - b. IEC 268-5 (1989) Sound system equipment – Part 5: Loudspeakers
 - c. IEC 268-12 (1987) Sound system equipment – Part 12: Application of Connectors for Broadcast and Similar Use
 - d. IEC 651 (1979) Sound level meters
 5. International Organization for Standardization (ISO)
 - a. ISO 1996-1 Acoustics – Description and measurement of environmental noise – Part 1: Basic quantities and – Composite Analog Video Signal – NTSC for Studio

Applications

6. Federal Specifications (FS)
 - a. GG-S-00172D Screen, Projection. Federal Supply Classification (FSC) 670.
7. Federal Standards (Fed-Std)
 - a. 191A Textile Test Methods.
 - 1) 5760 Mildew Resistance of Textile Materials; Mixed Culture Method.
 - 2) 5903.1 Flame Resistance of Cloth; Vertical.
8. NFPA
 - a. 255 Method of Testing Surface Burning Characteristics of Building Materials.
 - b. 701 Methods of Fire Tests for Flame-Resistant Textiles and Films.
9. Society of Motion Picture Engineers (SMPTE).
 - a. SMPT 196M-86 Motion Picture - Screen Luminance and Viewing Conditions - Indoor Theater Projection Guide.
 - b. SMPTE 202M-1998 Motion Pictures – B Chain Electroacoustic Response – Dubbing Theaters, Review Rooms and Indoor Theaters
 - c. SMPTE RP167-1995 Alignment of NTSC Color Picture Monitors
 - d. SMPTE EG1-1990 Alignment Color Bar Test Signal for Television Picture Monitors
 - e. SMPTE EG27-1994 Supplemental Information for ANSI/SMPTE 170M and Background on the Development of NTSC Color Standards (R1999)
 - f. RP 94 Recommended Practice for Gain Determination of Front Projection Screens.
 - g. SMPTE RP 95 Recommended Practice for Installation of Gain Screens.
 - h. SMPTE RP 98 Recommended Practice for Measurement of Screen Luminance in Theatres.
10. Underwriters Laboratories Incorporated (UL)
 - a. UL 813 Commercial Audio Equipment 1996
 - b. UL 1419 Professional Video and Audio Equipment 1997
 - c. UL 1492 Audio-Video products and Accessories 1996
 - d. UL 6500 Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use 1999

1.4 RELATED WORK BY OTHERS

- A. By Base Building Construction Contract.
 1. Division 26 - Power for all equipment.
 2. Section 27 05 00 – Common Work Results for Communications Systems
 3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
 - a. Empty raceway system for work of this Project, including floorboxes.
 4. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
 5. Section 27 15 00 – Communications Horizontal Cabling.

1.5 RELATED WORK IN OTHER SECTIONS

- A. Section 27 05 00 – Common Work Results for Communications Systems
- B. Section 27 05 26 – Grounding and Bonding for Communications Systems
- C. Section 27 05 29 – Hangers and Supports for Communications Systems
- D. Section 27 05 33 – Conduits and Backboxes for Communications Systems
- E. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
- F. Section 27 13 00 – Communications Indoor Backbone Cabling
- G. Section 27 15 00 – Communications Horizontal Cabling

1.6 QUALITY ASSURANCE

- A. Test Equipment: Provide in conformance with the applicable requirements of Section 27 05 00 – Common Work Results for Audiovisual Systems. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
 - 1. Sound Systems:
 - a. Wide band oscilloscope, 50 MHz, analog. (Example: Tektronix TAS-250 or 2212).
 - b. True RMS audio digital volt-ohm-millimeter (Example: Fluke 8060A).
 - c. Integrated audio test set (Example: Audio Precision or Neutrik A1 or A2 System).
 - d. Acoustic polarity tester (Example: BSS Audio Ltd. Phasecheck System AR 130).
 - e. Pink Noise generator (Example: Ivie IE-20B).
 - f. Calibrated microphone and pre-amplifier assembly (Example: Ivie IE-2P preamplifier/power supply with Ivie/ACCO, Bruel & Kjaer, or Larson-Davis microphone capsule).
 - g. Real time audio spectrum analyzer, one-third octave (Example: Ivie IE-30A or JBL Smaart system).
 - h. Frequency/time audio analyzer (Example: Crown TEF system or JBL Smaart system).
 - B. Baseband Video Systems:
 - 1. Wide band oscilloscope, 50 MHz, analog. (Example: Tektronix TAS-250 or 2212).
 - 2. Analog composite test generator (Example: Tektronix TSG 170A or TSG 100 Opt. 01).
 - 3. Analog composite waveform/vector monitor (Example: Tektronix 1740A or WFM 90.)
 - C. RGBHV Wideband Component Analog Video Systems:
 - 1. Wide band oscilloscope, 200 MHz, analog. (Example: Tektronix TAS-485).
 - 2. RGBHV test generator (Example: Extron VTG 300).
 - D. Projection Systems:
 - 1. Luminance meter. (Example: Tektronix J17/J18 with J1803 8 degree luminance head).
 - 2. Grey scale chart.

3. Precision optical comparator. (Example: Phillips or Tektronix J17/J18 with J1810/J1820 chromaticity head).
 - E. High-bandwidth Digital Content Protection (HDCP) check
 1. Quantum Data 882E HDMI-HDCP Compliance Test Tool
 - F. Structured Cabling used for Audiovisual Systems
 1. Level III field testers as defined in ANSI/TIA-1152 - Fluke, Agilent Or approved equal.
 2. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152
 3. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
 4. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
 5. Tone Test Sets.
 - G. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.
- 1.7 SUBMITTALS
- A. Conform with Section 27 05 00 – Common Work Results for Communications Systems.
- 1.8 CONFLICTS
- A. Present any conflicts between codes, regulations, specifications and/or requirements at least thirty (30) days prior to the commencement of the scheduled work.
- 1.9 SYSTEM PERFORMANCE REQUIREMENTS, AUDIO-VISUAL SYSTEM
- A. Using the listed test equipment, document that the installed systems meet or exceed the performance standards below.
 - B. Audio Playback and Sound Reinforcement Systems:
 1. Electrical Performance; Source Input to Power Amplifier Output:
 - a. Frequency Response (Equalizer flat): +0.5 dB 30 Hz to 15 kHz.
 - b. Total Harmonic Distortion (THD): Less than 0.5%, 30 Hz to 15 kHz, +4 dBm line level.
 - c. Signal to Noise: At least 70 dB, 30 Hz to 15 kHz, referenced to input of +4 dBm.
 - d. Crosstalk: At least -60 dB, 30 Hz to 15 kHz.
 2. Electro/Acoustic Performance:

- a. At PE Class Labs:
 - 1) Program audio to be capable of 96 dBA output level
 - 2) Ceiling speech reinforcement audio to be capable of 86dBA output level
 - b. All other spaces:
 - 1) Program audio to be capable of 86 dBA output level
 - 2) Ceiling speech reinforcement audio to be capable of 86dBA output level
 - c. Uniformity of Coverage: ± 6 dBA.
 3. Equipment: Specified individually.
 4. Audio Signal Path:
 - a. Shall not degrade performance of connected equipment.
 - b. Test all cabling from signal input to signal output to confirm signal loss not less than cable manufacturer's specification.
- C. Video Systems:
1. Video Signal System: NTSC to EIA RS-170A, except as noted.
 2. Video Signal Path: To EIA RS-250B short haul where equalized, otherwise to the performance limit of the specified video cable.
 3. Test all cabling from signal input to signal output to confirm signal loss not less than cable manufacturer's specification.
- D. RGBHV Video Systems:
1. Video Signal: Pass 300 Hz to 120 MHz sine wave from any input to any output with losses of less than 1 dB over cable loss at cable manufacturer specified performance points without amplification.
- E. Projection Systems:
1. Luminance testing consistent with performance of specified projectors and screens.
 2. Brightness, convergence per ANSI standard procedures for device.
 3. Measure (9) points of illuminance per screen and calculate average value in lumens.
- F. High-bandwidth Digital Content Protection (HDCP) check
1. At spaces with HDMI transmission:
 - a. Run HDCP check to ensure all devices are HDCP compliant.
 - b. Test with sample source device with quantity of HDCP keys as required to operate by the system.

1.10 TRAINING

- A. Conduct training on completed system at reasonable convenience of the District during normal District business hours.
- B. Operator Training: Eight (8) hours.
- C. Initial Use Support: Provide standby trainer/system engineer during two (2) system uses, each not to exceed four (4) hours of training.

1.11 DEFINITIONS

- A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:
1. Frequency Response: The minimum acceptable frequency band over which the amplitude response is within 3 dB (or any specified range), or the specified limits of the response relative to the reference frequency (1 kHz for audio, 1.0 MHz for video) under design load conditions, at any operating level up to and including the specified maximum output while fully in compliance with all other performance specifications.
 2. Maximum Output Level: The minimum acceptable maximum signal output level (voltage, current or power) attained under design load conditions attained while fully in compliance with all other performance specifications.
 3. Harmonic Distortion: The maximum acceptable harmonic distortion measured at any operating level, up to and including the specified maximum output, with an applied sine wave signal of any frequency in the range of the specified frequency response.
 4. Audio Intermodulation Distortion: The maximum acceptable intermodulation distortion resulting from the introduction of 60 Hz and 7 kHz signals in a ratio of 4:1 under design load conditions at any operating level up to and including the specified maximum output level.
 5. Signal to Noise Ratio: The minimum acceptable ratio of signal to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.
 6. Clipping Level: The minimum acceptable maximum level of signal applied to the device under design load conditions while fully in compliance with all other performance specifications.
 7. Sensitivity: The maximum acceptable level of input signal applied to the device that is necessary to provide the maximum output under design load conditions.
 8. Design Load: The load (in ohms) specified by usage of the particular device input or output.
 9. Composite Triple Beat Ratio: The ratio of visual carrier level to composite third order distortion products.
 10. Cross Modulation Ratio: The ratio of visual carrier level to coherent spurious signal level (i.e. intermodulation products).
 11. Carrier to Noise Ratio: The ratio of visual carrier to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.
- B. Signal Levels: The following voltage levels shall be considered the standard operating levels for the particular circuitry, unless specifically noted otherwise (0.775 Volt = 0 dBu = 0 dbm for a 600 ohms terminated circuit):
1. Microphone Circuits: -30 dBu or less.
 2. Audio Line Level Circuits: -30 dBu to +24 dBu; equivalent to -30 dBm to +24 dBm for a 600 ohms terminated circuit.
 3. Loudspeaker Level Circuits: More than +24 dBu.
 4. Video Line Level Circuits: 1.0 Volt, peak to peak composite signal.
 5. Radio Frequency (RF), Television (MATV) Circuits: +6 to +72 dBmV (0 dBmV = 1,000

microvolts).

- C. Characteristic Impedances: The following operating impedances shall be considered to be the standard operating impedances for the particular circuitry, unless specifically noted otherwise:
1. Microphone Circuits: 50-250 ohms source, 150-1500 ohms terminating, electrostatically and electromagnetically balanced to ground.
 2. Audio Line Level Circuits: 600 ohms maximum source, 600 ohms minimum terminating, line to line, electrostatically and electromagnetically balanced to ground.
 3. Video Line Level Circuits: 75 ohms maximum source, 75 ohms minimum terminating to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.
 4. Radio Frequency (RF) Television Circuits: 75 ohms nominal to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.

PART 2 PRODUCTS

2.1 GENERAL

A. Loudspeaker Substitutions

1. In addition to the procedures of Division 1 Product Substitution Procedures, for loudspeakers, the District's Representative may require a subjective evaluation test generally conforming to AES20-1996.
2. Perform the subjective evaluation test at the convenience of the District's Representative, at a location reasonably proximate to the Project site as agreed by the District's Representative.
3. Loudspeaker substitutions shall provide sound pressure level equal to the specified product at the target ear plane, seated or standing as applies. If the substitute loudspeaker is less sensitive than the specified loudspeaker, pursuant to Section 01 60 00 Product Substitution Procedures, the Contractor is responsible to provide greater amplifier power in the ratio of the inverse of the sensitivity difference.

2.2 SET-ATTACHED LOUDSPEAKERS

A. Sound Bar Speaker

1. Drawing Reference: SBS
2. Construction:
 - a. System Configuration 2-channel 2-way full-range for music / speech
 - b. Components & Loading (2) 3.5 " long-throw woofers and (1) 0.75" tweeter per channel
 - c. Recommended High-Pass Filter On-board 1st order @ 120 Hz; no outboard HP needed
 - d. Enclosure Type Low profile sealed enclosure
 - e. Enclosure Material Extruded ABS plastic with steel baffle insert
 - f. Finish: Black
 - g. Connectors Dual binding-head screws

- h. Suspension Hardware Universal mounting kit for direct attachment to display
 - i. Grille Integral fabric wrap
3. Minimum Features/Function/Performance:
- a. Frequency Response: 120 – 20,000 Hz, +/- 3 dB
 - b. Sensitivity 90 dB @ 2.83 volts / 1M
 - c. Impedance 8 ohm
 - d. Power Handling 90 W long term (AES-2) (per channel)
 - e. Maximum Output 103 dB long term; 109 dB peak
 - f. Nominal Coverage Angles 100° H x 120° V
 - g. Nominal Dimensions
 - 1) height: 4.13 “
 - 2) width: match display wall
 - 3) depth: 2.06 ”
 - h. Net Weight 15 lbs
4. Manufacturers:
- a. Innovox
 - b. Cambridge Sound
 - c. JBL
 - d. Or equal.

2.3 DISTRIBUTED LOUDSPEAKERS AND RELATED

- A. Provide tamper resistant fasteners at all assemblies mounted within 10 feet of finished floor in public occupancy spaces.
- B. Surface Mount Loudspeaker
 - 1. Drawing Reference: SP
 - 2. Manufacturer:
 - a. Tannoy
 - b. JBL
 - c. Or equal
- C. 6.5” 2-way Loudspeaker Assembly - 70V Coupled, Ceiling Mounted in T-Bar Ceiling or Concealed Spline or Fabric Wrapped Ceiling
 - 1. Drawing Reference: SA
 - 2. Manufacturer
 - a. Crestron Saros ICE6T-W-T
 - b. JBL Control
 - c. Or equal

2.4 POWER AMPLIFIERS AND RELATED

A. Power Amplifiers, General

1. Drawing Symbol: PA [number].
2. Provide the following functions and/or features
 - a. Employ solid state devices (integrated circuits and/or transistors) throughout and employ positive protection of circuit components.
 - b. With amplifier input driven 10 dB beyond input level required to produce full rated output, amplifier shall withstand for at least 15 seconds any of the following load conditions without instability or operation of main over current protection (i.e. no blown fuses or circuit breakers).
 - 1) "Short" circuit of 0.1 ohm.
 - 2) Open circuit (no load).
 - 3) Standard Reactive Load: 5.4 ohms in series with the parallel combination of 12.5 microhenrys; 800 microfarads and 18.3 ohms resistive.
 - c. Peak voltage of turn-on and/or turn-off transients not greater than 20 dB below maximum rated amplifier output.
 - 1) Time duration of transients not to exceed 3 seconds.
 - d. Input level controls for each output channel to be calibrated, stepped attenuators with at least 50 dB range.
 - 1) For 0 to 34 dB of attenuation, steps not to be greater than 2.0 dB.
 - 2) Attenuators to track calibration within 0.5 dB.
 - 3) Stepped attenuators are not required at Power Amplifiers where the connected driving source device includes a precision attenuator under digital control with precision not less than that specified herein.
 - e. Input Connectors: XLR connector or tip sleeve (standard) phone jack or barrier strip.
 - f. Output Connectors: Standard 0.75 inch spacing "5-way" binding posts, or barrier strip.
 - g. Where integral cooling fans are provided, such fans shall have a minimum life rating of 50,000 hours at 25 degree Centigrade ambient temperature.
 - h. Where indicated, provide balanced input, differential or transformer. Provide matching accessory to implement if not a standard feature of the product provided.
 - i. Listed by a Nationally Recognized Testing Laboratory.
3. Minimum performance requirements with all channels driven
 - a. Power Output Per Channel: As scheduled on Drawings as Minimum Amplifier (Min Amp) and specified below; continuous average sine wave power into 70 Volt line over a bandwidth of 40 Hz to 20 kHz.
 - 1) Frequency Response: plus 0 dB, minus 0.5 dB, 40 Hz to 20 kHz at rated output.
 - 2) Total Harmonic Distortion: Less than 0.25 percent at rated output, 40 Hz to 20 kHz.
 - 3) Intermodulation Distortion: Less than 0.04 percent at rated output using frequencies of 60 Hz and 7 kHz, mixed in a ratio of 4:1.

- 4) Input Impedance: 15,000 ohms minimum; unbalanced, or balanced as shown on drawings.
- 5) Hum & Noise: At least 94 dB signal-to-noise ratio.
- 6) Channel Separation: At least 75 dB at 1 kHz.
- 7) Phase Shift: Less than plus20 degrees from 20 Hz to 20 kHz.
- 8) D.C. Offset: Less than 10 millivolts.

B. Power Amplifiers, 2 Channel, 70 Volt

1. Drawing Symbol

- a. PA100-70
- b. PA200-70
- c. PA300-70
- d. PA600-70
- e. PA30-70
- f. PA40-70

2. Comply with Power Amplifiers, General, in this Section.

3. Power Output per Channel, continuous average sine wave power into 70 Volt line impedance, not less than.

- a. PA100-70, 100 Watts
- b. PA200-70, 200 Watts
- c. PA300-70, 300 Watts
- d. PA600-70, 600 Watts
- e. PA30-70, 30 Watts
- f. PA40-70, 40 Watts

4. Dimensions: Not to exceed 3 rack units for 2 channels.

- a. Manufacturer, PA100-70
 - 1) Crestron AMP-2100-70
- b. Manufacturer, PA30-70
 - 1) Crestron AMP-150-70
- c. Manufacturer, PA25-70
 - 1) Crestron AMP-225

2.5 VIDEO AND AUDIO SOURCE EQUIPMENT AND RELATED

A. Document Camera, Topset

1. Drawing Reference: DCAM, DOCCAM

2. Features:

- a. Camera: 1-CMOS 1/3", 30 frames per second in all resolutions
- b. Effective pixels of camera sensor: 1920x1080 (2,073,600)
- c. Native signal output: 1080p HD (1920x1080)

- d. Converted output signals (4:3 and 5:4): UXGA (1600x1200), SXGA (1280x1024) XGA (1024x768), SVGA, (800x600)
- e. Converted widescreen output signals (16:9 and 16:10): 720p HD (1280x720), WUXGA (1920x1200), WXGA (1280x800)
- f. Resolution (measured): 980 lines
- g. Brightness control & White balance adjustment: Automatic and manual
- h. Focusing Modes: High speed Continuous Autofocus, Manual Focus
- i. On-screen menu and on-screen help: Yes
- j. vSolution Link Pro software for remote management & firmware updates: Yes, included (for Windows 10 Desktop, Windows Server 2012 R2 & 2016)
- k. Free firmware updates: Yes, via USB, LAN, and vSolution Link Pro
- l. Zoom / Lens type: 12x zoom (6x optical, 2x digital), multiple-speed zoom wheel
- m. Max. object height on working surface: 200mm (8.0") in tele position 320mm (12.6") in wide position
- n. Max. pick-up area on working surface: Length: 290mm (11.42"), Width: 400mm (15.75")
- o. Min. pick-up area on working surface(full resolution, optical zoom): 66 x 50mm (2.6" x 2.0")
- p. Min. pick-up area on working surface (with digital zoom): 33 x 26mm (1.3" x 1.0")
- q. Depth of focus on small object: 66 x 36mm (2.6" x 1.4"): 15mm (0.6")
- r. Depth of focus on large object: 360 x 200mm (14.1" x 7.9"): 260mm (10.2")
- s. Light source: Maintenance-free, high-brightness LED light system (high light output, low power consumption), lamp lifetime: 30,000 hours
- t. UVC (Windows, Linux & macOS), PTP (Picture Transfer Protocol): Yes
- u. Reflection-free area on working surface: Yes, entire working surface
- v. Intelligent folding system: Yes, mechanical arm
- w. User-defined settings on USB stick: Yes
- x. User programmable presets: 1
- y. Swivel plate with 90° rotation: Optional
- z. External computer input/input switch: Yes, HDMI
- aa. Live to freeze comparison (Picture in Picture): Yes
- bb. Built-in digital scaler for the computer input: Yes (processes the signal from HDMI input for HDMI output)
- cc. Image memory: 1 image freeze
- dd. Alternative image display: Negative image / negative-blue image / black and white image
- ee. Connectors: 1x HDMI In, 1x HDMI Out, 1x LAN port, 1x mini USB 2.0 device port, 1x USB 2.0 host port
- ff. Advanced controlling with professional protocol: Yes, via LAN and USB
- gg. vSolution App compatible: Yes, wireless control via a mobile device (app available for

iOS, iPadOS, Android, and Windows)

- hh. Dimensions in operation (L x W x H): 488mm x 305mm x 525mm (19.2" x 12" x 20.7")
- ii. Dimensions when folded (L x W x H): 574mm x 305mm x 135mm (22.6" x 12" x 5.3")
- jj. Weight: 3.76kg (8.3lbs)
- kk. Anti-theft devices: T-Lock (Kensington® Lock), and table lock bolt
- ll. Power: External desktop power pack 12V: multi range 100-240V, 24W, Power over Ethernet Plus (IEEE 802.3at-2009 standard)
- mm. Included accessories: Cable shield, power supply with cord 1.8m (5'11"), LAN cable 1.8m (5'11"), mini USB cable 1.8m (5'11")
- nn. Optional accessories: Dry-erase working surface, carrying case
- oo. Warranty / Made In: 5 years/EU Austria

3. Manufacturer:

- a. Wolfvision VZ-3neo

B. Wireless Collaboration Gateway

1. Drawing Reference: WCG

2. Manufacturer:

- a. Extron Sharelink 250 Wireless Collaboration Hub

C. LCD/DLPRadio Frequency Receiver/Wireless Microphone System:

1. Drawing Reference(s):

- a. WREC
- b. WMIC - Wireless Mic, Handheld
- c. WMIC LAV - Wireless Mic, Lavalier
- d. ANT. DIST.
- e. Wireless microphone symbol.

2. Provide quantity of complete systems to match quantity of WMIC and WMIC LAV microphone symbols shown.

- a. Coordinate operating frequency with other UHF local sources, including but not limited to current television operating frequencies and DTV frequency allocations and/or local public safety operating frequencies to eliminate any interference from outside RF sources.
- b. Provide Receiver unit configured for diversity reception.
- c. Allows the expansion of wireless microphone systems by splitting one pair of antennas to multiple receivers. It also amplifies RF signals to compensate for insertion loss that results from splitting signal power to multiple outputs. A single system can support up to four wireless receivers.

3. Function/Features/Performance:

a. WREC/WMIC

- 1) Operating Range under Typical Conditions: 100m (300 ft.) Note: actual range depends on RF signal absorption, reflection, and interference.

- 2) Audio Frequency Response (+/- 2 dB): Minimum: 45 Hz; Maximum: 15 kHz
 - 3) Total Harmonic Distortion (ref. +/- 38 kHz deviation, 1 kHz tone): 0.5%, typical
 - 4) Dynamic Range: >100 dB A-weighted
 - 5) Operating Temperature Range: -18°C (0°F) to +57°C (+135°F)
Note: battery characteristics may limit this range
 - 6) Transmitter Audio Polarity: Positive pressure on microphone diaphragm (or positive voltage applied to tip of WA302 phone plug) produces positive voltage on pin 2 (with respect to pin 3 of low impedance output) and the tip of the high impedance 1/4-inch output.
- b. ANT. DIST.
- 1) Carrier Frequency Range: 470-952 MHz
 - 2) Distributed RF Output Level (Gain): -0.5 to 3 dB, 1 dB typical, from antenna input (unused ports terminated with 50)
 - 3) Output Connector Isolation: 30 dB, typical
 - 4) Third Order Intercept Point (3 OIP): 21 dBm, typical
 - 5) DC Input Voltage: 14 to 18 Vdc
 - 6) DC Output Voltage: 14 to 18 Vdc, 4 connectors
 - 7) Maximum Current Supply from DC Outputs: 1.5 Amps
 - 8) DC Antenna Voltage: 12 Vdc
 - 9) Impedance: 50 Ω
 - 10) RF Input/Output Antenna Connector Type: BNC
 - 11) Operating Temperature Range: -7° C to 49° C (20° to 120° F)
4. Manufacturer, WMIC/WMIC LAV System:
- a. Shure ULXD4 Digital Wireless Receiver w/ ULXD1 Wireless Body Pack Transmitter & WL185 Lavalier Microphone
 - b. Audio Technica
 - c. Sennheiser
 - d. Or equal
5. Manufacturer, ANT. DIST.
- a. Shure
 - b. Audio Technica
 - c. Sennheiser
 - d. Or equal

2.6 INSTRUCTOR'S LECTERN W/ RACKING COMPARTMENT

- A. Drawing Reference: where occurs (see AV device plan)
- B. Manufacturer:
 1. Spectrum 68020-20002 Teacher's Instruction Station w/ custom millwork cutout for Extron Cable Cubby 700

2. No known equal

2.7 AUDIO AND VIDEO PROCESSING, SWITCHING AND RELATED

A. Multi-format Audio/Video Switcher

1. Drawing Reference: AVSW1
2. Functions/Features:
 - a. AV matrix switcher, scaler, audio DSP, audio power amplifier, and control processor
3. Manufacturers
 - a. DMPS3-4k-150-C

B. Multimedia Receiver w/ Scaler

1. Drawing Reference: DMRX
2. Features/Functions
 - a. 4K60 4:4:4 HDR HDMI, HDR and HDCP2.2 compliant
 - b. Deep Color
 - c. 3D
 - d. DVI
 - e. Serial RS232 Communications
 - f. Infrared Control
 - g. VESA stream compression
 - h. HDCP 2.2
 - i. CEC
 - j. EDID format management
 - k. Enclosure
 - l. Metal, black finish, vented sides and front
 - m. 8" x 8" x 2"
 - n. Built-in video scaler: HD video scaler, motion-adaptive deinterlacer, interlacer, intelligent frame rate conversion, Deep Color support, 3D to 2D conversion, content-adaptive noise reduction
3. Manufacturers
 - a. Crestron DM-RMC-4KZ-100-C

C. Control Panel with integral processor and serial port, Hardwired, Module Style

1. Drawing References: CBP
2. Features:
 - a. Wall mount pushbutton control panel
 - b. Programmable buttons to accommodate control of a device's:
 - 1) Power On and Off
 - 2) Volume Up and Down

- 3) Source Select Toggle
 - a) Multiple pushes of a single button switches between controlled device's input sources
 - c. Communication: RS232
 - d. 1-gang, Decora wall-mountable
 3. Manufacturer:
 - a. Crestron BPC-8
 - b. or equal
- D. Touch Screen Control Panel
1. Drawing Reference: CTP (topset), CTW (wallmount)
 2. Features/Functions:
 - a. Screen:
 - 1) TFT Active matrix color LCD display
 - 2) 7" (17.8 cm), measured diagonally
 - 3) Resolution: 1024x600
 - 4) Pixel/pixel pitch: 170
 - 5) Aspect ratio: Widescreen
 - 6) Color depth: 24 bit, 16.7 million colors
 - 7) Transparency: 8 bit
 - 8) Brightness: 420 nits (cd/m²)
 - 9) Contrast: 700:1
 - 10) Backlight: LED
 - 11) Viewing angle: $\pm 75^\circ$ horizontal, $+70^\circ/-75^\circ$ vertical
 - 12) Touch screen: Capacitive
 - b. Memory:
 - 1) SDRAM 2 GB
 - 2) Flash 4 GB
 - c. Communication — Ethernet interface
 - 1) Ethernet control/communications port 1 female RJ-45 connector
 - 2) Ethernet data rate 10/100/1000Base-T, half/full duplex with autodetect
 - 3) Ethernet protocol DHCP, DNS, HTTP, HTTPS, ICMP, SFTP, SSH, TCP/IP, UDP/IP
 - d. IP address = 192.168.254.251
 - e. Subnet mask = 255.255.255.0
 - f. Default gateway = 0.0.0.0
 - g. DHCP = off
 - h. DNS = 127.0.0.1

- i. Software
 - 1) Configuration software Global Configurator Plus and Professional, GUI Designer
 - 2) Programming software Global Scripter
 - 3) Control apps Extron Control, iGVE
 - 4) Resource management software GlobalViewer Enterprise, iGVE
 - 5) Utilities Toolbelt, Embedded web page
- j. Communication — touchpanel
 - 1) Motion sensor On/off
 - 2) Light sensor On/off
- k. Control — USB
 - 1) Number/signal type 1 high-speed USB 2.0 device
 - 2) Connectors 1 USB type A connector
 - 3) USB standards USB 2.0, USB 1.1, USB 1.0 compatible
 - 4) USB data rates Low speed (1.5 Mbps), full speed (12 Mbps)
- l. Audio output
 - 1) Speaker output 1 mono, 86 dB SPL, 0.1 watt, 0.1 m, half space
 - 2) Frequency response 750 Hz to 20 kHz, ± 5 dB
 - 3) Playback format(s)
 - 4) Container format WAV (Microsoft RIFF)
 - 5) Encoding LPCM (uncompressed)
 - 6) Bit depth Unsigned 8-bit, Signed 16-bit, Signed 24-bit, Signed 32-bit
 - 7) Sampling rate up to 192 kHz
 - 8) Audio channels mono or stereo
- m. General
 - 1) Power supply Not included
 - 2) Power input requirements Power over Ethernet (PoE 802.3af, class 3)
 - 3) Power consumption — Power injector (XTP PI 100)
 - 4) Device 8.2 watts
 - 5) Device and power injector 10.6 watts
 - 6) Temperature/humidity Storage: -4 to +158 °F (-20 to +70 °C) / 5% to 90%, noncondensing
- n. Operating: -4 to +158 °F (-20 to +70 °C) / 20% to 90%, noncondensing
 - 1) Cooling Convection, vents on back
 - 2) Thermal dissipation — Power injector (XTP PI 100)
 - 3) Device 23.1 BTU/hr
 - 4) Device and power injector 31.3 BTU/hr
 - 5) Mounting Set on tabletop

- 6) Enclosure type Plastic
- 3. Manufacturers
 - a. Crestron TSW-760-TTK-B-S (CTP: w/ Tabletop Kit)
- E. Cable Cubby
 - 1. Drawing Reference: Occurs at each Instructor's Lectern
 - 2. Manufacturer:
 - a. Extron 70-1046-02 Cable Cubby 700 w/o AV module with:
 - 1) Extron 60-1697-01 AC/USB Power Module
 - 2) Extron 70-1065-08 Cable retractor DisplayPort-M to HDMI-M
 - 3) Extron 70-1065-04 Cable retractor HDMI
 - 4) Extron 70-1065-11 Cable retractor VGA/3.5mm
 - 5) Pass-through for Category cable
 - 6) Extron 70-1065-35 Cable retractor filler panel(s)
 - 7) Extron ASA-141 Passive Summing Audio Adaptor
 - 8) Cable Management Unit
 - 9) USB to micro-USB cable
 - b. Or equal
- F. AV Control System
 - 1. Drawing Reference: CONTROL
 - 2. Manufacturer:
 - a. Crestron 3 Series
- G. PoE Network Switch
 - 1. Drawing Reference: NSW
 - 2. Manufacturer:
 - a. Crestron CEN-SW-POE-5
- H. Multimedia Input Plate
 - 1. Drawing Reference: MP1
 - 2. Features/Functions
 - a. HDMI/VGA/analog stereo audio
 - 3. Manufacturers
 - a. Crestron DM-TX-200-C-2G-W
- I. Multimedia Connector Plate
 - 1. Drawing Reference: MP2
 - 2. Features/Functions:
 - a. Flush-in-wall AV Cable Port for Instructor's Lectern

- b. See detail sheets for jack layout:
 - 1) RJ45 (projector DM)
 - 2) Phoenix (screen control)
 - 3) RCA-female (70v distributed loudspeaker)
 - 4) RCA-female (ALS)
3. Manufacturers
 - a. Whirlwind
 - b. ProCo
 - c. Or equal

2.8 ASSISTIVE LISTENING SYSTEM (ALS):

A. General

1. Provide Infrared Type
2. Quantity of Devices per ALS Schedule, T-001.

B. ALS Transmitter

1. Drawing Symbol: ALS, ALS TX
2. Features
 - a. Balanced bridging line input.
 - b. Rack mounted.
 - c. Connector for remote-mounted emitter.
3. Manufacturer
 - a. Listen Technologies LT-84-01 Stationary Transmitter Rack Mounting Kit

C. ALS Emitter

1. Drawing Symbol: A
2. Features
 - a. IR emitter with mounting hardware, matching specified ALS TX.
3. Manufacturer
 - a. Listen Technologies LR-4200-IR.

D. Receivers and Accessories

1. Receiver
 - a. Stereo headphones
2. Manufacturer
 - a. Listen Technologies LA-402

E. Cable Management Unit

1. Manufacturer:
 - a. Listen Technologies LA-382

F. USB to Micro Cable

1. Manufacturer:
 - a. Listen Technologies LA-422

G. Battery Charger/Storage/Carry Case

1. Features
 - a. Store and charge up to 16 Receivers and related accessories.
 - b. Cover, latches and carrying handles.
 - c. Removable lid.
2. Quantity: To simultaneously recharge each received as scheduled on the plans
 - a. Manufacturer
 - b. Listen Technologies LA-381-01

2.9 VIDEO TERMINAL EQUIPMENT

A. Video Projectors, General Requirements

1. Video Projectors shall be purchased by the Contractor, using an equipment allowance allocated for such purposes. Exact specifications for Projector shall be developed in consultation with District at time of procurement.
2. Projector mounts shall include a locking mechanism keyed alike.

B. Video Projectors, high output

1. Drawing Reference(s): VPROJ
2. Function/Features/Performance:
 - a. Optical path: Optical Path: Laser diode, 1-Chip DLP, 3-Chip DLP or LCD, zoom lens.
 - b. Input signals:
 - 1) HDBaseT
 - 2) HDMI Video - at least one input.
 - 3) TCP/IP RJ-45 Ethernet
 - 4) USB port
 - c. Supported Video Standards: NTSC, NTSC4.43, PAL, PAL-60, PAL-M, PAL-N, SECAM
 - d. SD/HD Video Signal Compatibility: 1080i, 720p, 576p, 576i, 480p, 480i
 - e. Minimum Computer Video Signal Compatibility through native and translated inputs: VGA, SVGA, XGA, SXGA, SXGA+, UXGA
 - f. LCD panels: 0.8 inch minimum, active matrix, TFT.
 - g. Resolution, video: Not less than 600 lines for composite NTSC input.
 - h. Native Resolution: Not less than 1920x1200 pixels.
 - i. Colors: 16.7 million or greater
 - j. Contrast ratio: Not less than 1000:1.
 - k. Aspect ratio: 16:9. Auto-switches to 4:3 on receipt of program material in that format.

- I. Keystone correction:
 - 1) + 40 degrees vertical.
 - 2) + 35 degrees horizontal.
 - m. Scan rate horizontal: Not less than 15 to 100 kHz.
 - n. Scan rate vertical: Not less than 43 to 120 Hz.
 - o. Light flux, ANSI IT7.215 test procedure, not less than 6500 lumens
 - p. Projection laser diode life: 20,000 hours at half luminance.
 - q. Lens:
 - 1) Manufacturer or third party lenses available to permit the projector to be placed where shown while producing the indicated image size.
 - 2) Zoom lens with optical focus.
 - 3) Zoom ratio 1.33:1 minimum.
 - r. Switchable image inversion for front projection with projector installed upside down.
 - s. Integral Kensington cable lock tab.
 - t. Maximum Fan Noise: Not greater than 35 dBA at 3' from case.
 - u. Power consumption: Not to exceed 500 Watts at 120 Volts, single phase.
 - v. Dimensions: Not to exceed 9 inches high x 22 inches wide x 22 inches deep.
 - w. Weight: Not to exceed 50 pounds.
 - x. Control:
 - 1) Method: RJ-45, infrared or wired serial.
 - 2) Parameters, at least.
 - a) On/off.
 - b) Source select.
 - c) Luminance.
 - d) Chroma.
 - e) Gamma.
 - y. Heat management: Forced air.
3. Manufacturers:
- a. Panasonic PT-MZ670U 6500 lumens laser light engine w/ ET-ELW20 Zoom lens as required
- C. Video Projector Mount, Fixed, Ceiling
- 1. Construction
 - a. Pipe column or multiple joined runs of electrical support strut with vanity cover.
 - b. Channel and plate to mount to ceiling or wall as required.
 - c. Seismic restraint diagonal bracing as required.
 - d. Provide mount manufacturer's bottom plate to match projectors provided under Work of This Section.
 - e. Mount rated load capacity not less than 50 pounds.

- f. Allows safe adjustment of pitch, roll and yaw at least plus minus 5 degrees after installation of the mount and projector.
 - g. Allows for locking of pitch, roll and yaw settings after adjustment.
 - h. Allows removal and replacement of the projector without loss of the specific adjustment of pitch, roll and yaw.
2. Manufacturer, Video Projector Mount to Structure Above
- a. Chief Manufacturing RPA Series Inverted LCD/DLP Projector Ceiling Mount with
 - 1) CMA-110 Ceiling Plate 8" x 8" with 1 ½" NPT fitting.
 - 2) CMA-nnn Series Extension Column as required.
 - 3) CMA-640 Finishing Ring - Chrome.
 - 4) Lateral bracing per Architectural detail.
 - b. Westbrook Engineering, Inc. Promount Series.
 - c. Monger Mount.
 - d. Or equal.

2.10 PROJECTION SCREENS

- A. Projection Screen, Ceiling Mount, Motorized, Tab Tension, 16:9 Format
- 1. Drawing Reference(s): SCR, SCREEN
 - 2. Size: As indicated on drawings.
 - 3. Features/Functions:
 - a. 16:9 aspect ratio.
 - b. Seamless viewing area.
 - c. Electrical: 120 volts, single phase, 60 hertz.
 - d. Fabric: Flame and mildew resistant surface with black masking borders and black drop above the viewing surface.
 - e. Finish
 - 1) Classrooms: High contrast grey finish suitable for use with high output LCD or DLP projection.
 - 2) Lecture Hall: Matte White
 - f. Extra drop provide to drop screen within 4' above finished floor, unless otherwise indicated on the drawings.
 - g. Motorized operation with automatic travel stops.
 - h. Motor and roller: Reversible motor with permanent seal ball bearings, automatic thermal overload cut-out. Stressed truss roller minimum 5 inches (127 mm) diameter, mounted on steel brackets with heavy duty bearings.
 - i. Cable tensioning system at edges to ensure flatness.
 - j. UL listed.
 - k. Flat black edge finish.
 - l. Size: Viewable Screen Diagonal 161". Viewable Screen Height and Width 79" x 140.4". Contractor shall confirm screen fit between finish ceiling and 48"a.f.f. (bottom

of viewing area) prior to submittal.

- 1) Housing recessed in ceiling. Housing can be delivered to site and rough-in prior to placement of screen to protect screen from damage.
- m. Provision screen with all necessary screen manufacturer options to use indicated low voltage, closure operation. Receipt of serial control or contact closure from Audio-visual control system shall be sufficient to unroll screen for viewing, re-roll screen or to stop screen at intermediate point. Field adjustable down limit switch shall automatically stop screen in full down position.
4. Performance:
 - a. 0.9 gain on-axis gain. \pm .2.
5. Manufacturers
 - a. Drawing Reference: Refer to Enlarged RCP for Projection Screen Sizes.
 - 1) Draper Premier

2.11 SOUND CABLES AND RELATED

A. General

1. Provide cable with electrical **conductors** of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.
2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
 - a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.
3. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.
 - a. Code requirements take precedence.
 - b. Provide type required by Code at no additional cost to the District.

B. Cable, Microphone and Line Level, General Purpose

1. Drawing Symbol(s): SP.
2. Description: Shielded, single twisted pair, with #20 AWG color coded stranded conductors and foil shield with drain wire.
3. Performance/Construction
 - a. Conductors AWG #20.
 - b. Conductors Stranding: 7 by 28.
 - c. D.C. Resistance Per 1000 feet 15 ohms maximum.
 - d. Shield: Aluminum polyester foil with #20 AWG stranded tinned copper drain wire.
 - e. Diameter 0.24 inch maximum.
4. Where 2A indicated, provide 2 each SP
5. Manufacturer
 - a. Belden 8762
 - b. West Penn.

- c. Or equal.
- C. Cable, Microphone and Line Level, Miniature
- 1. Drawing Symbol: SP
 - 2. Restriction: For use within fixed equipment racks only.
 - 3. Description: Shielded, single twisted pair, with #22 AWG color coded stranded conductors and foil shield with drain wire.
 - 4. Performance/Construction:
 - a. Conductors AWG #22.
 - b. Conductors Stranding: 7 by 30.
 - c. D.C. Resistance Per 1000 feet: 20 ohms maximum.
 - d. Shield: Aluminum polyester foil with #24 stranded tinned copper drain wire.
 - e. Diameter 0.15 inch maximum.
 - 5. Where 2A indicated, provide 2 each SP
 - 6. Manufacturer
 - a. Belden 8451, 9451, 1266A.
 - b. Alpha.
 - c. West Penn.
 - d. Or equal.
- D. Cable, Loudspeaker and D.C. Power
- 1. Drawing Symbol(s)
 - a. #14TP, #14GA, #14AWG
 - b. #12TP, #12GA, #12AWG
 - 2. Description
 - a. Twisted pair, jacketed, unshielded cables, #12 or #14 as shown on Drawings.
 - 3. Plenum rated where installed in open plenum return voids.
 - 4. Performance/Construction
 - a. Conductor, AWG: #12, #14, as noted.
 - b. Maximum diameter
 - 1) 0.384 inch (#12)
 - 2) 0.332 inch (#14)
 - 5. Manufacturer
 - a. Belden.
 - 1) #12TP, Belden 8477
 - 2) #14TP, Belden 8473
 - 3) West Penn.
 - 4) Or equal.

2.12 VIDEO CABLES, COPPER COAX AND RELATED

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.
2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
 - a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.
 - b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.
3. Code requirements take precedence.
4. Provide type required by Code at no additional cost to the District.

B. Cable, Precision Video

1. Drawing Symbol(s): P-VIDEO.
2. Description: 100 percent sweep tested from 0.01 to 100 MHz, double braided shield solid center conductor 75 ohms coaxial precision video cable.
3. Performance
 - a. Cable Type: Coaxial precision video.
 - b. Center Conductor AWG: Twenty (20) bare copper.
 - c. Insulation: Polyethylene.
 - d. Shield: Tinned copper double braid, minimum 98 percent coverage.
 - e. Nominal Impedance: 75 ohms.
 - f. Velocity of Propagation: 66 percent.
 - g. Attenuation Per 100 feet:
 - 1) 1.0 MHz: 0.25 dB
 - 2) 4.5 MHz: 0.45 dB
 - 3) 10.0 MHz: 0.78 dB.
 - h. Jacket: Polyethylene.
 - i. Diameter: 0.305 inch maximum.
4. Manufacturer
 - a. Belden 9209A.
 - b. Canare
 - c. Gepco
 - d. Or equal.

C. Cable, Miniature Precision Video

1. Drawing Symbol: Miniature Precision Video.
2. Description: 100 percent sweep tested from 0.01 to 100 MHz, braided shield plus foil shield, stranded center conductor 75 ohms coaxial miniature precision video cable.

3. Performance
 - a. Cable Type: Coaxial precision video.
 - b. Center Conductor AWG: 22 or 23 bare copper.
 - c. Center Conductor Stranding: 7 by 30 or 7 by 32.
 - d. D.C. Resistance Per 1000 feet: 15 ohms maximum.
 - e. Insulation: Cellular Polyethylene.
 - f. Shield: 100 percent foil plus trimmed copper braid, 95 percent coverage.
 - g. Nominal Impedance: 75 ohms.
 - h. Velocity of Propagation: 66 percent.
 - i. Attenuation Per 100 feet:
 - 1) 1.0 MHz: 0.15 dB
 - 2) 10.0 MHz: 1.3 dB
 - 3) 100 MHz: 5.0 dB.
 - j. Jacket: Polyethylene.
 - k. Diameter: 0.240 inch maximum.
 4. Manufacturer
 - a. Belden 9209A.
 - b. Canare LV-61S.
 - c. Or equal.
- D. Cable Set, Audio Video, Manufactured
1. Provide signal type as indicated on Drawings.
 2. Manufacturer
 - a. Liberty Wire & Cable Interflex Z-200 and Z-300 Series
 - b. Markertek
 - c. Or equal.
- E. Cable, SVideo
1. Plan Reference(s): SV, SVideo
 2. Construction
 - a. 2 miniature precision coax cables in an overall shielded overall jacket to transmit NTSC analog component video based on the separation of chrominance and luminance transmission method.
 - b. Jacket: Code approved equal for application.
 - c. Overall two sub cable assembly diameter: 0.33" maximum in raceway applications.
 3. Performance:
 - a. Conductor DC Resistance: 41 Ohms / 1000ft. max
 - b. Capacitance: 16.7 pf/ft.
 - c. Impedance: 75 Ohm -5 +2 Ohms

- d. Time Delay: 1.22ns/ft.
 - e. Velocity of Propagation: 83%
 - f. Attenuation
 - 1) 1.22 dB/100 ft.: 5 MHz
 - 2) 3 dB/100 ft.: 30 MHz
 - 3) 5.34 dB/100 ft.: 90 MHz.
 - g. Construction: Two precision video cables in one overall jacket.
4. Manufacturer:
- a. Altinex CB5620PL in plenum spaces, riser rated elsewhere.
 - b. Belden
 - c. West Penn
 - d. Extron
 - e. Or equal.
- F. Cable, Data Monitor Precision Video
1. Plan Reference(s):
- a. D5 Video
2. Construction
- a. 5 miniature high resolution coax cables in an overall shielded overall jacket to transmit analog component video based on the Red-Green-Blue-Horizontal Sync-Vertical Sync (RGBHV) transmission method.
 - b. Sub cables are color coded Red, Green, Blue, Black, Grey; or approved alternate color coding scheme.
 - c. Jacket: Code approved equal for application.
 - d. Overall five sub cable assembly diameter: 0.56" maximum in raceway applications.
 - e. Center Conductor AWG: Twenty two (22) ga Silver Plated Copper.
 - f. Insulation: Foamed Teflon.
 - g. Shield:
 - 1) Each subcable is double shielded
 - 2) Overall cable has 100% tape shield.
3. Approval/Rating:
- a. UL: Recognized Type CL2P (Article 725 of NEC) for plenum application, riser rated elsewhere.
4. Performance - each sub-cable:
- a. Resistance: 0.0162 ohms/ft. nominal @ 20C
 - b. Impedance: 75 ohm nominal
 - c. Capacitance: 17.5 pf/ft. nominal
 - d. Velocity of Propagation: 80% nominal
 - e. Time Delay: 1.19ns/ft. nominal

- f. Maximum Attenuation Per 100':
 - 1) 10 MHz: 0.8 dB/100 ft.
 - 2) 50 MHz: 2.5 dB/100 ft.
 - 3) 100 MHz: 3.5 dB/100 ft.
 - 4) 200 MHz: 4.6 dB/100 ft.
 - 5) 300 MHz: 5.0 dB/100 ft.
 - 6) 400 MHz: 7.2 dB/100 ft.
 - 7) 1000 MHz: 14.6 dB/100 ft.
- g. Manufacturers:
 - 1) Altinex CB5100PL in plenum spaces, riser rated elsewhere.
 - 2) Extron
 - 3) Belden
 - 4) Gepco.
 - 5) Or equal.

G. Multimedia Cable:

- 1. Drawing Reference: Multimedia Cable
- 2. Description: 100% sweep tested (0.01 to 1000 MHz) double braided shield solid center conductor 75 ohms coaxial precision video cable and shielded, single twisted pair, with #26 AWG color coded stranded conductors and foil shield with drain wire.
- 3. Construction:
 - a. Seven (7) miniature high resolution video coax cables (for RGBHV and S-Video use) and (6) twisted pairs (for audio) in an overall jacket
 - b. Color coded.
 - c. Diameter: 0.57" maximum.
 - d. Jacket: Flamarest or Code approved equal for application.
 - e. CL Listed.
 - f. Center Conductor AWG: Twenty (26) ga bare copper.
 - g. Shield: Aluminum/Polyester Tape.
- 4. Performance - Each miniature high resolution video coax cable:
 - a. Capacitance: 16 pF/ft. Max
 - b. Nominal Impedance: 75 ohms.
 - c. Velocity of Propagation: 82%.
 - d. Attenuation Per 100':
 - 1) 10 MHz: 1.6 dB
 - 2) 100 MHz: 6.1 dB
 - 3) 1000 MHz: 30.4 dB.
- 5. Acceptable, subject to above:
 - a. Altinex CB4600MR.

- b. No Known Equal.

H. DVI Cabling

1. Drawing Reference: DVI/HDMI
2. Features/Functions
 - a. The plans indicate the required distances for HDMI format transmission. Contractor to provide a transmission system appropriate to the indicated lengths. Contractor engineered solutions may consist of:
 - 1) Passive HDMI cabling, where the indicated length is within the service distance of such systems.
 - 2) Copper HDMI cabling and active HDMI repeaters
 - 3) Fiber Optic Cabling and HDMI transceivers.
 - b. Contractor to select and provide the method of transmission appropriate to the length and operating parameters of the selected transmission system as defined by the manufacturers of the cabling systems, the repeaters and/or transceivers and the HDMI transmission standard as defined at www.hdmi.com.
3. Manufacturers, copper cabling and extenders:
 - a. Extron
 - b. Broaddata
 - c. Altinex
 - d. Liberty Cable
 - e. Or equal.

2.13 CONTROL CABLING

A. Category Media Cabling

1. Drawing Reference(s): AV Net
2. Features/Functions:
 - a. 1 cable equivalent to a 2 pair, 18 gauge cable suitable for RS-485 (A/V Net) signaling and remote device powering.
3. Manufacturers:
 - a. Crestron Crestnet-P
 - b. Liberty Wire & Cabling
 - c. AMX
 - d. Extron
 - e. Or equal.

B. High Speed, TIA/TIA Category Cabling

1. Drawing Reference:** UTP6-4, where ** denotes cable count
2. Construction:
 - a. Provide horizontal copper cable in accordance with:
 - 1) EIA ANSI/TIA/EIA-568-B.2,

- 2) UL 444,
- 3) NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)
- 4) ICEA S-90-661
- b. UTP (unshielded twisted pair),
- c. 100 ohm impedance
- d. Four each individually twisted pair, 22 or 24 AWG conductors,
 - 1) Color code
 - 2) Pair 1 White/Blue Blue
 - 3) Pair 2 White/Orange Orange
 - 4) Pair 3 White/Green Green
 - 5) Pair 4 White/Brown Brown
- e. No shield in the sheath.
- f. Jacket
 - 1) Thermoplastic jacket
 - 2) Color: Blue unless otherwise indicated.
 - 3) Cable imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 2 feet.
 - 4) The word "FEET" or the abbreviation "FT" shall appear after each length marking.
 - 5) Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
 - 6) Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.
3. Certification
 - a. Warrantied by the manufacturer to provide Category 6 performance when installed in accordance with applicable EIA/TIA standards and when terminated with the jacks supplied by the Contractor for this Project.
4. Performance
 - a. Assembly electrically meets or exceeds EIA ANSI/TIA/EIA-568-B.2 Category 6 performance standards
5. Manufacturers:
 - a. Crestron
 - b. Commscope Systimax
- C. High Speed, Category 6 Cabling, Plenum Rated
 1. Drawing Reference:** UTP6-4P, where ** denotes cable count
 2. Construction:
 - a. As for non-plenum, with fire retardant overall jacket construction.

- b. UL listed, NEC compliant for plenum installation.
- c. CSA Certified type PCC FT4 FT6.
- 3. Manufacturers
 - a. As for non-plenum Cat. 6, plenum construction.

2.14 MISCELLANEOUS PRODUCTS

A. Cable Termination Devices and Related:

- 1. Screw-type or Tubular Clamp Barrier Blocks:
 - a. Buchanan 125, 0625 Series.
 - b. Electrovert equivalent.
 - c. TRW-Cinch 140, 141, 142 Series.
 - d. Weidmuller equivalent.
 - e. Pass & Seymour/Legrand equivalent.
 - f. Phoenix equivalent.
- 2. Tubular Clamp Barrier Blocks, High Density, Switch Block Section
 - a. Drawing Reference: TB15.
 - b. Features/Functions
 - 1) Paired screw terminals on opposite sides of insulating base.
 - 2) TB15 Base mounts to DIN rail, providing space beneath TB15 to dress field and source cabling.
 - 3) Terminates range of wire gages used by project – at least 30 gage to 10 gage.
 - 4) High density:
 - a) At least 33 pairs of connections per foot for 12 and smaller gage terminations,
 - b) At least 16 pairs of connections per foot for 10 gage terminations.
 - 5) Switch Block Section permits load, such as field devices, to be separated from monitoring panel for testing independent of source then restored without disturbing field wiring terminations.
 - 6) Rated at least fifteen (15) amperes at 300V AC/DC
 - c. Approvals
 - 1) UL
 - d. Manufacturers:
 - 1) Allen Bradley Isolation Switch Blocks,
 - a) 1492-H7 for 30 to 12 gage
 - b) 1492-CE9 for 10 gage.
 - 2) Tyco Buchanan 0135 Series.
 - 3) WECO Electrical Connectors
 - 4) Altech
 - 5) Curtis Industries

- 6) Electrovert
 - 7) Weidmuller
 - 8) Pass & Seymour/Legrand
 - 9) Phoenix
 - 10) Or equal.
3. Low Level Audio Cable Termination, Insulation Displacement Products
 - a. Coordinate with wire size, type and insulation
 - b. Manufacturer
 - 1) ADC "Dense Patch".
 - 2) Siemon Model S66M450 with D10 Designation Strip.
 - 3) Or equal.
- B. Audio and Control Connectors and Related:
1. Circular Audio Connector, Cord, 3 through 5 contacts, gold plated contacts, captive cable clamp strain relief, matte black chrome finish over nickel metal shell
 - a. Neutrik C-Series, X-Series.
 - b. Switchcraft.
 - c. Or equal.
 2. Circular Audio Connector, Panel mount, male and female devices to fit same panel cutout including fasteners, 3 through 5 contacts, gold plated contacts, matte black chrome finish over nickel metal shell, female receptacles locking type:
 - a. Neutrik D Series Version L.
 - b. Switchcraft
 - c. Or equal.
 3. Loudspeaker Connector, Panel mount, female devices to fit same panel cutout including fasteners as other panel mount receptacles, 4 contacts, matte black finish Polyamid/graphite shell, female receptacles locking type. UL Component Recognized:
 - a. Neutrik NL4MP.
 - b. Switchcraft
 - c. Or equal.
- C. Video Connectors and Related
1. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated from panel, double female
 - a. Manufacturer
 - 1) Canare BCJ-JRU.
 - 2) Tec Nec
 - 3) Liberty Wire & Cable/Panelcraft
 - 4) Or equal.
 2. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated

from panel, single female to solder pin

- a. Manufacturer
 - 1) Canare BCJ-RU.
 - 2) Tec Nec
 - 3) Liberty Wire & Cable/Panelcraft
 - 4) Or equal.
3. Video connector, BNC type, 75 ohms, cord, crimp applied. Coordinate with cable.
 - a. Manufacturer
 - 1) Amp.
 - 2) McDonaldAmphenol.
 - 3) Augat/LRC Products
 - 4) Canare.
 - 5) Kings.
 - 6) Liberty Wire & Cable/Panelcraft
 - 7) RFI/Celltronics.
 - 8) Trompeter.
 - 9) Or equal.
4. Video Precision 75 ohms Terminator, BNC:
 - a. Manufacturer
 - 1) Canare BCP-TA
 - 2) Trompeter TNAI-1-75.
 - 3) Or equal.
5. XGA Connectors, DB15
 - a. Drawing Reference HD15
 - b. Manufacturer
 - 1) Amp.
 - 2) Amphenol.
 - 3) Canare.
 - 4) Kings.
 - 5) Liberty Wire & Cable/Panelcraft
 - 6) RFI/Celltronics.
 - 7) Or equal.

D. Custom Facility Panels and Rackmount Auxiliary Panels

1. Provide connector types and plate finish as shown. If none shown, provide:
 - a. Rack mount panels: Steel Panel, black finish.
 - b. Wall Panels: Steel, finish to match surrounding electrical and other low voltage panels.

2. Manufacturer
 - a. PanelCrafters Division of Liberty Wire & Cable, Classic Series
 - b. Whirlwind
 - c. RCI Systems
 - d. Or equal.
- E. Power Supplies and Related:
 1. Drawing Reference: PS24.
 2. Relay and Lamp Power Supply:
 3. 24 VDC, regulated within 5%. Ripple not greater than 1.5%. Output current rating at least 150% of maximum possible load. Circuit breaker or intrinsic over current protection. UL Recognized or UL Listed.
- F. Power Panel:
 1. Drawing Reference: POWER.
 2. Functions/Features:
 - a. Front face of panel shall provide two electrical power outlets and a switch. An indicator lamp shall show the presence of AC power when on. The front face of panel shall have a black finish. The rear face shall provide a minimum of at least four receptacles. The panel shall be racked mounted in a maximum of two rack units. The panel shall be Code approved and UL rated for this application.
 3. Manufacturers:
 - a. Hubbell
 - b. Geist
 - c. Or equal

PART 3 EXECUTION

3.1 GENERAL

- A. Perform the Work of this Section in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.
- B. Furnish and install (herein, "provide") all materials, devices, components, and equipment required for complete, operational systems.

3.2 WIRING CLASSIFICATION AND RELATED

- A. Audio Signal Wiring Classification:
 1. Type A-1: Microphone level wiring less than -30 dB μ , 20 Hz to 20 kHz.
 2. Type A-2: Line level wiring -30 dB μ to +24 dB μ , 20 Hz to 20 kHz.
 3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dB μ , from 20 Hz to 20 kHz.
- B. Video and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
 2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
 3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
 4. Type V-4: MATV system wiring 0.1 to 1000 uV peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.
- C. Control Signal Wiring Classifications:
1. Type C-1: DC control wiring 0 to 50 volts.
 2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
 3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.
- D. Additional Wiring Classifications:
1. Type M-1: DC power wiring 0 to 48 volts.
 2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.
- E. Wiring Combinations:
1. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Contract Drawings.
 - a. Types A-1, C-1, and M-1.
 - b. Types A-2, C-1, C-2, and M-1, runs less than twenty (20) feet.
 - c. Types A-2, C-1, and M-1.
 - d. Types A-3, C-1, C-2, and M-1.
 - e. Types A-2, V-1, and V-3.
 - f. Types V-1, V-2, V-3, and C-1.
 - g. Types M-2 and C-3.

3.3 WIRE AND CABLE INSTALLATION

- A. Provide permanent identification of run destination at all raceway terminations.
- B. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
- C. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
- D. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings, make splices only in designated manholes and/or handholes. Protect splices outside of buildings with splicing kits equivalent to Scotchcast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.

- E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- F. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
- G. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- H. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
- I. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

3.4 SIGNAL POLARITY CONVENTION

- A. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Comply with AES26-2001. Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.

- B. Audio signal connector convention: Comply with AES 14-1992 (r1998)

<u>Signal</u>	<u>Connector</u>	<u>Wire</u>
Signal Phase	Pin 2	Red or White
Signal Anti-Phase	Pin 3	Black
Signal Ground	Pin 1	Drain Wire

- C. Video and RF/MATV Connector Convention:

<u>Signal</u>	<u>Connector</u>	<u>Wire</u>
Signal Phase	Center Pin	Center conductor
Signal Anti-Phase	Shell	Shield
Signal Ground	Shell	Shield

3.5 WIRING PRACTICE

- A. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option, such terminals may be located in the equipment racks or in the terminal cabinets provided. Coordinate such selection with Project construction sequence and test procedures specified herein.

- B. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one (1) inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Conform to the requirements of Section 27 05 00.
- C. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size. Plier type crimp tooling shall not be acceptable.
- D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to "Sharpie".
- F. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
- G. Use only rosin core 60/40 tin/lead solder for all solder connections.
- H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.
- I. Termination and buildout resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.
- J. Correct any and all of the following unacceptable wiring conditions:
 - 1. Deformed, brittle or cracked insulation.
 - 2. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
 - 3. Cold solder joints.
 - 4. Flux joints.
 - 5. Solder splatter.
 - 6. Ungrommated, unbushed, or uninsulated wire or cable entries.
 - 7. Deformation or improper radius of wire or cable.

3.6 SIGNAL GROUNDING PROCEDURES

- A. Comply with National Electrical Code.
- B. Unless otherwise noted maintain a unipoint ground scheme.
- C. Signal and electrical system grounds shall be isolated except at the Project ground field connection.

- D. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.
- E. Ground and bond equipment racks and similar equipment enclosures containing powered equipment exclusively via the Isolated Ground conductors provided under Division 26. INSULATE RACK MOUNTING, ANCHORAGE, AND RACEWAY CONNECTIONS.
- F. At each rack, provide an Isolated Ground bus within the rack. At each rack, provide a lug bonded to the rack frame with a #12 TW stranded wire to the rack Isolated Ground bus.
- G. At each ensemble of racks, provide a single labeled Isolated Ground tubular-clamp bus bar terminal strip to land the individual rack Isolated Ground bus ground conductors. Connect the main Isolated Ground conductor from the Technical Power panelboard at this point.
- H. Equipment signal ground shall be to the Isolated Ground System via the green wire of the equipment power cord. Where equipment uses two (2) wire power cord, provide #12 green bond wire to rack IG bus bar. At equipment, provide crimp lug and suitable hardware for bonding.
- I. Shielded cables of this section shall be grounded exclusively to Isolated Ground by a single path. Shield shall be tied to Isolated Ground at one end only, i.e., at the low potential (receiving) end of run, unless otherwise noted.
- J. Unless otherwise noted, at audio jackfields, tie source shield at jackbay frame. Float shields at connections to output jacks. Bus each row of jack frames and run individual #12 green ground wire for each row to rack IG bus bar.
- K. Signal Ground provisions shall realize less than 0.15 ohms to the primary ground connection.

3.7 FINISHES

- A. Finishes and materials for contractor fabricated assemblies such as racks, custom control panels, brackets, and blank panels, equipment mounting in furniture or casework, speaker baffles, speaker grille material and in general any item or component herein which is visible shall adhere to the following:
 - 1. Finish shall be as directed by the District.
 - 2. In the event that the District provides no direction as to finish, finish shall match exactly the surrounding and adjacent surfaces.
 - 3. Wooden speaker back boxes and baffles shall be painted flat black if not otherwise finished or stained.

3.8 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

- A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.
- B. Within each equipment enclosure, provide a full-height multi-circuit ISOLATED GROUND outlet strip with branch circuit count as shown on drawings; locate on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.

- C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.
- D. Maintain separation of wiring classifications as specified herein. Separately dress, route and land microphone and line level cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level and control cables on the left side of the equipment enclosure, as viewed from the rear.
- E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.
- G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.
- H. At jackfields, provide service loop to permit removal of jackfields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.
- I. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.
- J. At each equipment backboard, provide UL Listed surge suppressing multioutlet assembly with at least six (6) receptacles.

3.9 EQUIPMENT RACK AND EQUIPMENT BACKBOARD TESTING AND ADJUSTING PROCEDURES

- A. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Request and coordinate verification of submitted test data by the representative of the Architect. Correct all non-conforming conditions prior to shipment to Project Site. Perform at least the following procedures:
 - B. Preliminary: Verify:
 - 1. Grounding of devices and equipment. Integrity of signal and electrical system ground connections.
 - 2. Proper provision of power to devices and equipment.

3. Integrity of all insulation, shield terminations and connections.
 4. Integrity of soldered connections. Absence of solder splatter, solder bridges.
 5. Absence of debris of any kind, tools, etc.
 6. Routing and dressing of wire and cable.
 7. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
 8. Mechanical integrity of all support provisions.
- C. Rig temporary power and grounding. Comply with all applicable Codes, regulations and ordinances.
- D. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 168 hours.
- E. Sound Systems:
1. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for optimum signal-to-noise ratio and signal balance and, unless they are sub-panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such that in a given system the "front end" operates at unity gain and maintains 10 dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, a result of testing by the representative of the District.
 2. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio-frequency pickup using broadband oscilloscope. Correct any such defects.
 3. Hum and noise level/signal to noise level/signal to crosstalk level: Maintain previous setup. Terminate microphone and line-level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with -40 dBm input level at a microphone input and +12 dBm at a line-level input. Measure and document the specified parameters of the system overall for each microphone input channel and line-level input channel. Compare with nominal signal level.
 4. Total Harmonic Distortion: Maintain previous setup. Measure at reference operating level at least at 63 Hz, 125 Hz, 1 kHz, 10 kHz.

3.10 LABELING

- A. Conform to the requirements of Section 27 05 53 – Identification for Communications Systems.
- B. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

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SECTION 28 1300

ACCESS CONTROL AND INTRUSION DETECTION

PART 1 - GENERAL

1.1 REFERENCE TO GENERAL CONDITIONS

- A. The General Conditions shall be considered as forming an integral part of the specifications and shall be carefully examined before bid for any work submitted.
- B. Comply with Division 1 requirements and documents referred to herein.

1.2 SUMMARY

- A. Provide all labor, materials, equipment, fabrication, programming, installation and tests for a complete and functional Access Control and Alarm Monitoring System (ACAMS) in conformity with Owner requirements and applicable Codes and Authorities Having Jurisdiction.

1.3 RELATED SECTIONS

- A. Division 01 – General Requirements
- B. 07 9200 Joint Sealants
- C. 26 0000 – Electrical
- D. 27 0000 – Communications

1.4 SYSTEM DESCRIPTION

- A. The Access Control and Intrusion Detection
- B. The Access Control and Alarm Monitoring System (ACAMS) outlined in this section and detailed in PART 2 of this document is the key central component for managing physical security for this project.
- C. The system shall provide a variety of integral functions including the ability to regulate access and egress; provide identification credentials; monitor, track, and interface alarms; and view, record and store digital surveillance video linked to ACAMS events.
- D. The Owner provided ACAMS Server shall communicate to the IP Door Controller and associated intrusion detection panels via a network communication.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 3000 – Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Manufacturer's Product Data: Submit manufacturer's data sheets indication systems and components proposed for use.

- D. Shop Drawings: Submit complete shop drawings indicating system components, wiring diagrams and load calculations.
- E. Record Drawings: During construction maintain record drawings indicating location of equipment and wiring. Submit an electronic version of record drawings for the Security Management System not later than Substantial Completion of the project.
- F. Operations and Maintenance Data: Submit manufacturer's operation and maintenance data, customized to the Security Management System installed. Include system and operator manuals.
 - 1. Quality Assurance
 - a. All system components must be installed by a Contractor of established reputation and experience who has completed similar installations, utilizing the systems and devices specified for this project, for a period of at least three (3) years and who will be able to refer to similar installations rendering satisfactory service.
 - b. Contractor who will be performing services for the District must maintain all current licenses and manufacturer certifications required to provide the specific work efforts of this Contract for which they were hired.
 - c. The Contractor must utilize installation and service technical who are factory trained and certified by the specified system manufacturer and who can install and maintaining the system and providing reasonable service time. Copies of technician's certifications for the technicians performing work on this project, must be submitted by the Contractor with the original bid. Failure to submit these documents may result in rejection of the Contractor's Bid.
 - 2. Delivery, Storage, and Handling
 - a. Store products in manufacturer's unopened packaging until ready for installation.
 - 3. Project Conditions
 - a. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
 - 4. Warranty
 - a. Manufacturer's Warranty: Submit manufacturer's standard warranty for the security management system.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL AND ALARM MONITORING SYSTEM PRODUCTS

- A. Application
 - 1. Locations where electronic access control devices are to be used include:
 - a. Main Office Entrance.
 - b. IDF/Electrical rooms.
 - c. Classrooms
- B. System Description
 - 1. Provide Access Control and Alarm Monitoring System (ACAMS) card reader, alarms, as indicated on the drawings and specified herein.
 - 2. System shall be modular in nature and capable of accommodating connectivity as desired by the Owner.
 - 3. Provide all system components required to interface the system with the Owner's network (under other divisions).
 - 4. The intelligent controller shall be located as indicated on the Drawings.

5. The network backbone shall be provided by the Telecommunications Contractor. The network switching equipment shall be provided by the Owner. Provide all equipment & materials required to connect the ACAM System to the IP network. Coordinate network requirements with the Telecommunications Contractor and Owner.
 6. Acceptable Manufacturer: Panels and controllers, Mercury Security Series 3 Hardware, through OEM or equal. Card Readers: HID Signo Series or equal.
- C. IP Door Controller (IPDC):
1. Provide IPDC's as necessary for a complete and functional system.
 2. Acceptable Manufacturers: Mercury Security LP1502, or equal.
 3. The SMS shall provide card reader, workstation, or time schedule control through file server programming of electric locking mechanisms as designated by the Owner.
 4. The Intelligent Controller shall provide for monitoring of the open/closed status of card reader-controlled doors through normally closed magnetic door position switches provided as part of the System. In addition, the ACAMS shall monitor the card reader for invalid card use. The ACAMS shall annunciate each condition individually.
 5. The SMS shall shunt the door position switch alarm monitoring for a predefined time-period upon the use of a valid request to exit device or a card reader provided as part of the card reader-controlled door. This process shall be programmable and shall allow the door to be opened without generating a forced/intrusion alarm for the time-period defined. The SMS shall generate a held open/door prop alarm if the door is still open once the predefined entry/exit time-period has elapsed.
- D. Card Reader
1. Card readers must be wired and configured to use OSDP V2.
 2. The Card Reader shall be a multi technology model with the capability to read multiple card formats, including smartcard, proximity, etc. It shall read encoded data from access cards and transmit the data to the IPDCs. The operating frequency shall meet all local regulations.
 3. A multi-color LED on the face of the Card Reader and an audible tone shall indicate authorized and unauthorized reader uses.
 4. No system compromise shall be possible from circuitry located in the reader unit.
 5. The Card Reader shall have provision to operate as specified in environments of electromagnetic and radio frequency interference as well as spurious electrical line interference. When installed according to manufacturer's instructions the reader shall operate properly when mounted adjacent to or directly on any material including metal without the use of standoff or space.
 6. The Card Reader shall have a minimum read range of two (2) inches.
 7. Provide manufacturer recommended power to each reader directly from the IPDC or a secondary supply. The power supply shall be UL Class 2, power limited and shall provide necessary output voltage to allow the card reader to operate at its maximum specified read range.
 8. Acceptable Manufacturers: HID Signo S20 mullion mount, or equal.
- E. Electrified Locking Mechanisms
1. Electrified locking mechanisms shall be provided by the door hardware contractor as indicated on the Drawings. Refer to Architectural door schedule, drawing A8.1.
 2. Assume electrified locking hardware is equipped with integral request to exit function. Wire the REX sensor to the REX input of the access control system.
 3. Interface with electrified locking mechanisms as indicated on the Drawings.
- F. Electrified Locking Mechanism Power Supply

1. Provide Power Supplies for all electric locking mechanisms as specified.
 2. Provide Power Supplies for all electric locking mechanisms
 3. Provide battery chargers and batteries sufficient for four (4) hours of backup power for the connected load for all power supplies except those for fail-safe locks.
 4. Monitor low battery and power fail alarms for each Power Supply.
 5. Minimum Specifications:
 - a. Type: UL Listed Class II power limited
 - b. Input Voltage: 120VAC 60 Hz
 - c. Output Voltage: 24 VDC
 - d. Output Connections: Individually fused outputs to each lock
 - e. Output Rating: 150% of actual connected load
 - f. Battery: Sealed gel type
 - g. Alarm Outputs: Low battery and power fail
 - h. Enclosure: Steel enclosure with integral lock and tamper switch
 6. Acceptable Manufacturers: Altronix, or approved equal
- G. Request-to-Exit Device
1. Electrified locking hardware is equipped with integral request to exit function. Interface to request to exit switches integral to electrified locking hardware. Wire the REX sensor to the REX input of the access control system.
- H. Device Power Supply
1. Provide Power Supplies for all ACAMS equipment as required.
 2. Monitor low battery and power fail alarms for each power supply.
 3. Minimum Specifications:
 - a. Type: UL Listed Class II power limited
 - b. Input: 120VAC 60 Hz hard wired
 - c. Output: Regulated and filtered 24VDC
 - d. Output rating: 150% of the actual connected load
 - e. Battery backup: Four (4) hours of rechargeable backup at full load
 - f. Battery: Sealed gel type
 - g. Alarm outputs: Low battery and power fail
 - h. Enclosure: Key lockable wall mount housing with tamper switch
 4. Acceptable Manufacturers: Altronix AL600ULACM, or approved equal
- I. Door Position Switch
1. Provide normally closed (N/C) magnetic door position switches to monitor the open/closed status of doors as specified herein and as indicated on the Drawings.
 2. Concealed Door Position Switch
 - a. Minimum Specifications:
 - 1) Gap: ½" between the magnet and switch
 - 2) Configuration: N/C
 - 3) Mounting: 1" diameter hole in door and frame
 - b. Acceptable Manufacturers: GE Interlogix 1078 Series, or approved equal
 3. Surface Mount Door Position Switch
 - a. Minimum Specifications:
 - 1) Gap: 3" between the magnet and switch

- 2) Configuration: N/C
 - 3) Mounting: Surface mount to door and frame
 - b. Provide armored cable from the switch location to the associated junction box in order to conceal the wire.
 - c. Acceptable Manufacturers: GE Interlogix 1045 Series, or approved equal
- J. Tamper Switch
1. Provide normally closed tamper switches to monitor the secure status of all panels, power supplies, and power distribution units.
 2. Include the number of tamper switches in the total alarm input figures.
 3. Minimum Specifications:
 - a. Type: Plunger
 - b. Configuration: N/C
 - c. Mounting: Within cabinet with no outside access to fasteners
 4. Acceptable Manufacturers: GE Interlogix 3010, or approved equal
- K. Closed Circuit Television (CCTV)
1. The Cameras shall be a multielement model with the capability to view a minimum of 270 degrees
 2. The units shall be mounted to the building as indicated on the drawings
 3. The contractor shall be responsible to assure that the camera provided is compatible with the clients existing VMS system and provides all the functionality of the VMS/camera manufacturer
 4. The Cameras shall have provision to operate as specified in environments of electromagnetic and radio frequency interference as well as spurious electrical line interference. When installed according to manufacturer's instructions the camera(s) shall operate properly when mounted adjacent to or directly on any material including metal without the use of standoff or space.
 5. The installer shall provide all ancillary mounting hardware to facilitate mounting the cameras on the corner of the building and connection to the provided electrical raceways.
 6. The contractor shall provide all necessary cable, fiber and interconnect devices to assure an end-to-end signal from cameras to the VMS headend.
 7. Provide manufacturer recommended power to each camera from the network PoE if possible or provide a secondary supply as needed (Coordinate with clients' IT department). The secondary power supply shall be UL Class 2, power limited and shall provide necessary output voltage to allow all the cameras to operate at their maximum draw.
 8. Acceptable Manufacturers: Axis model P3717-PLE or equal

2.2 INTRUSION DETECTION SYSTEM

- A. Application
1. Locations where intrusion detection devices are to be used include:
 2. Door Position Switches
 - a. Perimeter Doors

2.3 NETWORKING EQUIPMENT

- A. Access control panels, IPDC's and IP cameras shall communicate to the server via the Owner's network (provided under other Division).

- B. Provide all necessary equipment for the system to connect to the network switching equipment, provided by Owner, and communicate over the Owner's network.
- C. Wire for all security devices needs to be specified with the appropriate cable types as defined by the applicable manufacturers.

PART 3 - EXECUTION

3.1 COORDINATION

- A. At a minimum, coordinate the following with the Owner:
 - 1. Coordinate programming information.
 - 2. Coordinate final device locations and installation and operational requirements.
 - 3. Custom report requirements. Submit report templates to the Owner for review and acceptance.
 - 4. Coordinate equipment labeling.
 - 5. Coordinate cable jacket colors.
 - 6. The location and orientation of each piece of rack mounted equipment.
 - 7. Initial database partitioning and setup prior to initial programming and cardholder data entry.
 - 8. Coordinate training curriculum, syllabus, and schedule.
- B. At a minimum, coordinate with the following other trades:
 - 1. Electrical.
 - 2. Fire/Life Safety System
 - 3. Door Hardware
 - 4. Verify that adequate power has been provided and properly located for the security system equipment. Coordinate circuit, breaker, and panel locations and identify locations in record documents.

3.2 INSTALLATION

- A. General
 - 1. Coordinate equipment installation requirements with other trades prior to installation.
 - 2. After installation, protect equipment to prevent damage during the construction period. Close openings in conduits and boxes to prevent the entrance of foreign materials.
 - 3. Make equipment connections in accordance with the approved submittal drawings and manufacturer specifications.
 - 4. Seal exterior devices to protect against weather conditions including heat, cold, moisture, dust, and sand.
- B. Equipment - Provide equipment as specified herein. Additional specific installation requirements are as follows:
 - 1. Card Readers
 - 2. Electric Locking Mechanisms
 - a. Interface with electric locking mechanisms provided by the door hardware supplier.
 - b. Wire electric locking mechanisms as indicated on the Drawings.

3.3 LABELED FRAMES AND DOORS

- A. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.
- B. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Owner.

3.4 SURGE PROTECTION

- A. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
- B. Provide surge protection for all power circuits, telephone, network, and other communication circuits, and electronic modules.
- C. Provide equipment submittals for all proposed surge protection for review prior to ordering or installing.

3.5 POWER REQUIREMENTS

- A. Electrical contractor to provide 120 VAC power requirements dedicated to security as indicated on the drawings.
- B. Connect to the AC power to locked power supply cabinets. Provide UL listed power supplies and transformers with plug type connectors to distribute low voltage power to the system components as required. Plug transformers into duplex receptacles supplied under the electrical specification within locked cabinets as needed. Plug transformers shall be fastened to the duplex receptacle to prevent disconnection.

3.6 CONDUIT AND JUNCTION BOXES

- A. Electrical contractor to provide conduit and junction boxes.

3.7 PROJECT COMPLETION PROCESS

- A. System Programming
 - 1. Submit system-programming forms to the Owner. Include dates that the Owner must have the forms completed to maintain the construction schedules.
 - 2. Program the security systems.
- B. Final Testing Scripts
 - 1. Provide proposed testing scripts and written methods and procedures at least 3 weeks prior to final testing.
 - 2. Testing scripts shall include a written description for each piece of equipment in the system that describes the effect to the system if that piece of equipment fails.
 - 3. Coordinate with the Owner to determine exact formats for testing scripts.

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SECTION 28 3100

NETWORKED FIRE ALARM & VOICE EVACUATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expandable emergency evacuation fire alarm system

1.2 RELATED SECTIONS

- A. Section (27 1500) – (Communications Horizontal Cabling).

1.3 REFERENCES

- A. Electrical Industries Association (EIA):
 - 1. RS-232-D – Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
 - 2. RS-485 – standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code (NEC)-2013
 - 2. NFPA 72 – National Fire Alarm Code-2013
 - 3. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 4. NFPA 101 – Life Safety Code-2013
 - 5. NFPA 5000 – Building Construction and Safety Code.
- C. Underwriters Laboratories (UL):
 - 1. UL 268 – Standard for Smoke Detectors for Fire Alarm Signaling Systems.
 - 2. UL 864 9th Edition – Standard for Control Units and Accessories for Fire Alarm Systems.
 - a. UOJZ, Control Units, System.
 - b. UOXX, Control Unit Accessories, System.
 - 3. UL 1971 – Standard for Signaling Devices for the Hearing Impaired.

1.4 SYSTEM DESCRIPTION

- A. A new intelligent reporting, Style 7 networked, fully peer-to-peer, microprocessor-controlled fire detection and emergency voice alarm communication system shall be installed in accordance with the specifications and as indicated on the Drawings.
- B. Each Signaling Line Circuit (SLC) and Notification Appliance Circuit (NAC): Limited to only 80 percent of its total capacity during initial installation.
- C. Control Panel shall be expandable from 2 to 128 SLC loops as necessary to accommodate future expansion
- D. Basic Performance:

1. Network Communications Circuit (NetSOLO) Serving Network Nodes: Wired using single twisted non-shielded 2-conductor cable or connected using approved fiber optic cable between nodes in Class A configuration.
2. Signaling Line Circuits (SLC) Serving Addressable Devices: Wired Class B
3. Initiation Device Circuits (IDC) Serving Non-addressable Devices Connected to Addressable Monitor Modules: Wired Class B
4. Notification Appliance Circuits (NAC) Serving Strobes, Horns and Speakers: Wired Class B
5. On Class A Configurations: Single ground fault or open circuit on Signaling Line Circuit shall not cause system malfunction, loss of operating power, or ability to report alarm.
6. Alarm Signals Arriving at INCC COMMAND CENTER: Not be lost following primary power failure until alarm signal is processed and recorded.
7. Transponders:
 - a. Operate in peer-to-peer fashion with other panels and transponders in system.
 - b. Each transponder shall store copy of audio evacuation messages and tones.
 - c. Systems that use centralized message storage and control at main fire alarm control panel shall not be acceptable.
8. Network Node Communications, Audio Evacuation Channels:
 - a. Communicated between panels and transponders on single twisted pair of copper wires or fiber optic cables.
 - b. To enhance system survivability, ability to operate on loss of INCC Command Center, short or open of entire riser at INCC Command Center shall be demonstrated at time of system acceptance testing.
9. Signaling Line Circuits (SLC):
 - a. Reside in remote transponders with associated audio zones.
 - b. SLC modules shall operate in peer-to-peer fashion with all other panels and transponders in system.
 - c. On loss of INCC Command Center, each transponder shall continue to communicate with remainder of system, including all SLC functions and audio messages located in all transponders.
 - d. Systems that provide a "Degraded" mode of operation upon loss of INCC Command Center or short in riser shall not be acceptable.
10. Audio Amplifiers and Tone-Generating Equipment: Electrically supervised for normal and abnormal conditions.
11. Amplifiers: Located in transponder cabinets serving no more than 3 floors per transponder to enhance system survivability, reduce required riser wiring, simplify installation, and reduce power losses in length of speaker circuits.
12. Speaker NAC Circuits: Arranged such that there is a minimum of 1 speaker circuit per fire alarm zone.
13. Notification Appliance Circuits (NAC), Speaker Circuits, and Control Equipment: Arranged such that loss of any 1 speaker circuit will not cause loss of any other speaker circuit in system.
14. Speaker Circuits:
 - a. Electrically supervised for open and short circuit conditions.
 - b. If short circuit exists on speaker circuit, it shall not be possible to activate that circuit.
 - c. Arranged for 25 or 70 VRMS and shall be power limited in accordance with NEC
 - d. 20 percent spare capacity for future expansion or increased power output requirements.
15. Speaker Circuits and Control Equipment:

- a. Arranged such that loss of any 1 speaker circuit will not cause loss of any other speaker circuit in system.
 - b. Systems utilizing "bulk" audio configurations shall not be acceptable.
- E. Basic System Functional Operation: When fire alarm condition is detected and reported by 1 of the system alarm initiating devices, the following functions shall immediately occur:
1. System Alarm LEDs: Flash.
 2. Local Piezo-Electric Signal in Control Panel: Sound at a pulse rate.
 3. 80-Character LCD Display: Indicate all information associated with fire alarm condition, including type of alarm point and its location within protected premises.
 4. Historical Log: Record information associated with fire alarm control panel condition, along with time and date of occurrence. History Log shall have capacity for recording up to 4,100 event.
 5. System output programs assigned via control-by-event equations to be activated by particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
 - a. Close Fire Doors
 - b. Shot down air handlers as required by code
 - c. Notify the Central Station.
 6. Strobes flash synchronized continuously.
 7. Audio Portion of System: Sound alert tone followed by pre-recorded message determined by event and this scenario repeating or other message as approved by local authority until system is reset...
- F. Fire Alarm System Functionality:
1. Provide complete, electrically supervised distributed, Class A networked analog/addressable fire alarm and control system, with analog initiating devices, integral multiple-channel voice evacuation, and fire fighter's phone system.
 2. Fire Alarm System:
 - a. Consist of multiple-voice channels with no additional hardware required for total of 4 channels.
 - b. Incorporate multiprocessor-based control panels, including model E3 Series modules includes Intelligent Network INCC Command Center(s) (INCC), Intelligent Loop Interface (ILI-MB-E3), Intelligent Network Transponders (INX), communicating over peer-to-peer token ring network with standard capacity of up to 64 nodes expandable to 122.
 3. Each ILI-MB-E3 Node: Incorporate 2 Signaling Line Circuits (SLC), with capacity to support in Velociti® mode up to 159 analog addressable detectors and 159 addressable modules per ILI-MB-E3 SLC.
 4. Voice, Data Riser: Transmit over single pair of wires or fiber optic cable.
 5. Each Intelligent Network Transponder: Capable of providing 16 distributed voice messages, fire fighter phones connections, SLC loop for audio control devices, and integral network interface.
 6. Each Network Node: Incorporate Boolean control-by-event programming, including as a minimum AND, OR, NOT, and Timer functions.
 7. Control Panels: Capability to accept firmware upgrades via connection with laptop computer, without requirement of replacing microchips.
 8. Network:
 - a. Based on peer-to-peer token ring technology operating at 625 K baud, using Class A configuration.
 - b. Capability of using twisted-pair wiring, pair of fiber optic Multi-mode cable strands up to 200 microns or Single-mode optimized for 9/125 microns, or any combination, to maximize flexibility in system configuration.
 9. Each Network Node:
 - a. Capability of being programmed off-line using Windows-based software supplied by fire alarm system manufacturer. Capability of being

- downloaded by connecting laptop computer into any other node in system. Systems that require system software to be downloaded to each transponder at each transponder location shall not be acceptable.
- b. Capability of being grouped with any number of additional nodes to produce a "Region", allowing that group of nodes to act as 1, while retaining peer-to-peer functionality. Systems utilizing "Master/Slave" configurations shall not be acceptable.
 - c. Capability of annunciating all events within its "Region" or annunciating all events from entire network, on front panel LCD or touchscreen display without additional equipment.
10. Each SLC Network Node: Capability of having integral DACT (digital alarm communicator transmitter) that can report events in either its region, or entire network to single central station monitoring account.
 11. Each Control Panel: Capability of storing its entire program, and allow installer to activate only devices that are installed during construction, without further downloading of system.
 12. Password Protection: Each system shall be provided with 4 levels of password protection with up to 16 passwords.
 13. Have the capacity for multiple pre-recorded messages (at least sixteen (16), but more if required by local AHJ) and address a list of subjects.
 - a. Fire evacuation and relocation
 - b. Intruder or hostile person sighted within or around the building grounds
 - c. Directions to occupants to take cover within building
 - d. Emergency weather conditions appropriate for local area
 - e. All Clear

1.5 SUBMITTALS

- A. Comply with Section 01 3300 Submittal Procedures.
- B. Include sufficient information, clearly presented, to determine compliance with the specifications and the Drawings.
- C. Equipment Submittals:
 1. Cover Page: Indicate the following:
 - a. Project name and address.
 - b. Engineered systems distributor's name and other contact information.
 - c. Installing contractor's name and other contact information.
 - d. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
 2. Table of Contents: Lists each section of equipment submittal.
 3. Scope of Work Narrative: Detail indented scope of work.
 4. Sequence of Operations: Use matrix or written text format, detailing activation of each type of device and associated resulting activation of the following:
 - a. Control panel.
 - b. Annunciator panels.
 - c. Notification appliances.
 - d. Building fire safety functions
 5. Bill of Material: Indicate for each component of system the following:
 - a. Quantity.
 - b. Model number.
 - c. Description.
 6. SLC Circuit Schedule: Detail address and associated description of each addressable device. Clearly provide information that indicates number of both active and spare addresses.

7. Battery Calculations: Show load of each of, and total of, components of system along with standby and alarm times that calculations are based on. Show calculated spare capacity and size of intended battery.
- D. Shop Drawings:
1. Cover Page: Indicate the following:
 - a. Project name and address.
 - b. Engineered systems distributor's name and other contact information.
 - c. Installing contractor's name and other contact information.
 - d. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
 2. Floor Plans:
 - a. Prepare to scale 1/8 inch = 1'-0", unless otherwise required by the Architect or Engineer.
 - b. Show equipment and device locations.
 - c. Show wiring information in point-to-point format.
 - d. Show conduit routing, if required by the AHJ.
 3. Title Block: Provide on each sheet and include, at a minimum, the following:
 - a. Project name.
 - b. Project address.
 - c. Sheet name.
 - d. Sheet number.
 - e. Scale of drawing.
 - f. Date of drawing.
 - g. Revision dates, if applicable.
 4. Control Panel: Provide sheet that details exterior and interior views of control panel and clearly shows associated wiring information.
 5. Annunciator Panels: Provide sheet that details exterior and interior views of annunciator panels and clearly shows associated wiring information.
- E. Certification: Submit with equipment submittals and shop drawings, letter of certification from major equipment manufacturer, indicating proposed engineered system distributor is an authorized representative of major equipment manufacturer.
- F. Project Record Drawings:
1. Submit complete project record drawings within 14 calendar days after acceptance test.
 2. Project record drawings shall be similar to shop drawings, but revised to reflect changes made during construction.
- G. Operation and Maintenance Manuals:
1. Submit complete operation and maintenance manuals within 14 calendar days after acceptance test.
 2. Operation and maintenance manuals shall be similar to equipment submittals, but revised to reflect changes made during construction.
 3. Include factory's standard installation and operating instructions.

1.6 QUALITY ASSURANCE

- A. Codes and Standards:
1. NFPA: System shall comply with the following NFPA codes and standards
 - a. NFPA 70-2013
 - b. NFPA 72-2013
 - c. NFPA 90A.
 - d. NFPA 90B When smoke control is required by code.
 - e. NFPA 101-2013

- f. NFPA 5000.
 - 2. ADA: System shall conform to American with Disabilities Act (ADA).
 - B. To ensure reliability and complete compatibility, all items of fire alarm system, including control panels, power supplies, initiating devices, and notification appliances, shall be listed by Underwriters Laboratories Inc. (UL) and shall bear "UL" label.
 - C. Fire Alarm Control Panel Equipment: UL-listed under UL 864 Ninth Edition.
 - D. Equipment, Programming, and Installation Supervision:
 - 1. Provide services of approved engineered systems distributor of Gamewell-FCI for equipment, programming, and installation supervision.
 - 2. Provide proof of factory training within 14 calendar days of award of the Contract.
 - E. Software Modifications:
 - 1. Provide services of Gamewell-FCI factory-trained and authorized technician to perform system software modifications, upgrades, or changes.
 - 2. Provide use of all hardware, software, programming tools, and documentation necessary to modify fire alarm system software on-site.
 - 3. Modification includes addition and deletion of devices, circuits, zones, and changes to system operation and custom label changes for devices or zones.
 - 4. System structure and software shall place no limit on type or extent of software modifications on-site.
 - 5. Modification of software shall not require power-down of system or loss of system fire protection while modifications are being made.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials from damage during handling and installation.

1.8 COORDINATION

- A. Coordinate the Work of this section with the Work of other sections, including sprinkler systems as specified in Section 23 0000, Heating Ventilating Air Conditioning.

1.09 WARRANTY

- A. Warranty Period for System Equipment: 1 year from date of final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Gamewell-FCI, Honeywell Fire Systems, 12 Clintonville Road, Northford, Connecticut 06472. Phone (203) 484-7161. Fax (203) 484-7118. Website: www.gamewell-fci.com.
- B. References to manufacturer's model numbers and other information is intended to establish minimum standards of performance, function, and quality. Equivalent equipment from Gamewell may be substituted for the specified equipment, as long as minimum

standards are met. No other manufacturers, other than Gamewell-FCI, FCI, and Gamewell will be considered for use on this project.

- C. Substitute equipment proposed as equal to equipment specified shall meet or exceed requirements of this section. For equipment other than Gamewell-FCI E3 Series Expandable Emergency Evacuation Fire Alarm System, provide proof that such substitute equipment equals or exceeds features, functions, performance, and quality of specified equipment. This proof shall be provided by submission of a copy of specification with each copy of the submittals that has had each paragraph marked as either compliant or non-compliant along with a letter from engineering manager or product manager at factory that certifies information presented as either compliant or non-compliant including a detailed explanation of each paragraph identified as non-compliant. In order to ensure that the Owner is provided with a system that incorporates required survivability features, this letter shall also specifically certify that the system is capable of complying with the test requirements of this section.

2.2 DISTRIBUTED NETWORKED FIRE ALARM SYSTEM

- A. Distributed Networked Fire Alarm System: Gamewell-FCI E3 Series Expandable Emergency Evacuation Fire Alarm System.

2.3 INTELLIGENT NETWORK INCC COMMAND CENTER HARDWARE

- A. Intelligent Network INCC Command Center (INCC): Supply user interface, including LCD or touch-screen 1/4 VGA display Intelligent Loop Interface Modules (ILI-MB-E3), manual switching, and microphone inputs to the network. INCC shall consist of the following units and components:
1. System Cabinet (B-, C-, or D-Size Cabinet) with associated inner door.
 2. Power Supply Module (PM-9) with batteries.
 3. Intelligent Network Interface Voice Gateway (INI-VG).
 4. 80-Character LCD Display (LCD-E3).
 5. Intelligent Loop Main Board Interface (ILI-MB-E3).
 6. Optional Intelligent Loop Supplemental Interface (ILI-S-E3).
 7. Optional DACT (DACT-E3).
 8. Optional ARCNET Repeater (RPT-E3) with fiber optic modules (FSL-E3 or FML-E3).
 9. Optional 1/4 VGA touch-screen display (NGA).
 10. Optional Auxiliary Switch Module (ASM-16).
 11. Optional LED Driver Module (ANU-48)
 12. Optional Microphone Assembly (INCC-MIC).
 13. Optional Telephone Assembly (INCC-TEL).
 14. Optional AM-50 Series amplifiers (AM-50, AM-50-70).
 15. Optional Addressable Node Expander (ANX-SR, ANX-MR-FO, ANX-MR-UTP).
- B. System Cabinet:
1. Surface or semi-flush mounted with texture finish.
 2. Consist of back-box, inner door, and door.
 3. Available in at least 3 sizes to best fit project configuration.
 4. Houses 1 or more PM-9 Power Supply Modules, INI-VG Intelligent Network Interface Voice Gateway, 1 or more ILI-MB-E3 assemblies, and other optional modules as specified.
 5. Construction: Dead-front steel construction with inner door to conceal internal circuitry and wiring.
 6. Wiring Gutter Space: A minimum of 1-inch wiring gutter space behind mounting plate.

7. Wiring: Terminated on removable terminal blocks to allow field servicing of modules without disrupting system wiring.
- C. Power Supply Module (PM-9): Use latest technologies to provide power to the Control Panel and incorporate the following features:
1. Power-saving switching technology using no step-down transformers.
 2. 9-amp continuous-rated output to supply up to all power necessary under normal and emergency conditions.
 3. Integral battery charger with capacity to charge up to 55 amp-hour batteries while under full load.
- D. Batteries:
1. Sufficient capacity to provide power for entire system upon loss of normal AC power for a period of 24 hours with 15 minutes of alarm signaling at end of this 24-hour period, as required by NFPA 72, Local Systems.
- E. Intelligent Network Interface Voice Gateway INCC Command Center (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall have the following features as a minimum:
1. Microprocessor shall monitor all system events and perform all system programs, for all control-by-event (CBE) functions. System program shall not be lost upon failure of both primary and secondary power. Programming shall supporting Boolean logic including AND, OR, NOT, TIMING functions for maximum flexibility.
 2. Network Interface: Operate at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 nodes in peer-to-peer fashion.
 3. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions.
 4. Microphone Input: On-board and allow for addition of local microphone when used as INCC Command Center, including speaker circuit control.
 5. Signal Processing: INCC shall use advanced Digital Signal Processing (DSP) technology to allow maximum flexibility of digital audio and control capabilities and operation. Signals to and from INCC shall be transmitted over single pair of twisted unshielded wire or fiber optic pair.
 6. Field Programmable: INCC shall be capable of being fully programmed or modified by Field Configuration Program (FCP), to be downloaded via portable computer from any node in system.
 7. Control-by-Event Programming (CBE): INCC shall be capable of programming using Boolean logic including AND, OR, NOT, COUNT, TIMING, and SCHEDULE functions to provide complete programming flexibility.
 8. Remote INCC Command Center: System shall have capability of adding remote INCC Command Centers or re-locating INCC Command Centers utilizing only single pair of twisted unshielded wire or fiber optic pair for all functions.
 9. RS-485 Serial Output: System shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet.
 10. Riser Wiring: All data and voice riser shall transmit over single pair of twisted unshielded wire or fiber optic pair for all functions configured in Class A format. Any short or open in data or voice sections shall not affect transmission over remainder of network.
 11. Class A Network: All communication between control panels and transponders shall be through supervised Style 7 token passing network. In event of single short, open, or ground, all system communication shall operate as normal and report fault. This protection shall incorporate all data and voice transmissions.

Upon single short, open, or ground of either system data, live voice, pre-recorded channels, or phone risers, the function of each of these items shall continue to operate. "Degrade" functionality shall not be acceptable. This shall be demonstrated at system acceptance.

- F. LCD Display Module (LCD-E3):
1. LCD Display: 80-character RS-485 based textual annunciator with capability of being mounted locally or remotely. Provides audible and visual annunciation of all alarms and trouble signals. Provide dedicated LEDs for:
 - a. AC Power On: Green.
 - b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. System Trouble: Yellow.
 - e. Power Fault: Yellow.
 - f. Ground Fault: Yellow.
 - g. System Silenced: Yellow.
 2. 80-Character Alphanumeric Display: Provide status of all analog/addressable sensors, monitor and control modules. Display shall be liquid crystal type (LCD), clearly visible in dark and under all light conditions.
 3. Panel shall contain 4 functional keys:
 - a. Alarm Acknowledge.
 - b. Trouble Acknowledge.
 - c. Signal Silence.
 - d. System Reset/Lamp Test.
 4. Panel shall contain 3 configuration buttons:
 - a. Menu/Back.
 - b. Back Space/Edit.
 - c. OK/Enter.
 5. Panel shall have 12-key telephone-style keypad to permit selection of functions.
- G. Intelligent Loop Interface (ILI-MB-E3): System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. Intelligent Loop Interface shall be capable of mounting in stand-alone enclosure or integrated with Intelligent Network INCC Command Center (INCC) as specified.
1. Field Programmable: System shall be capable of being programmed by Field Configuration Program (FCP), allowing programming to be downloaded via portable computer from any node on network.
 2. RS-232C Serial Output: Supervised RS-232C serial port shall be provided to operate remote printers and/or video terminals, accept downloaded program from portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Communication shall be standard ASCII code operating from 1,200 to 115,200 baud rate.
 3. RS-485 Serial Output: Each ILI-MB-E3 shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet. RS-485 bus shall support up to 16 ASM-16 auxiliary switch modules, 6 LCD-E3 main annunciators, and 5 LCD-7100 annunciators.
 4. Peer-to-Peer Panel Configuration: All Loop Interface Modules shall incorporate own programming, log functions, Central Processor Unit, and control-by-event (CBE) programming. If any loop becomes disabled, each remaining loop driver shall continue to communicate with remainder of network and maintain normal operation. "Degrade" configurations under these conditions shall not be acceptable.
 5. Control-by-Event (CBE) Program: ILI-MB-E3 shall be capable of programming using Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions to provide complete programming flexibility.

6. Alarm Verification: Smoke detector alarm verification shall be standard option while allowing other devices such as manual stations and sprinkler flow to create immediate alarm. This feature shall be selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.
7. Alarm Signals: All alarm signals shall be automatically latched or "locked in" at control panel until operated device is returned to normal and control panel is manually reset. When used for sprinkler flow, "SIGNAL SILENCE" switch may be bypassed, if required by AHJ.
8. Electrically Supervised:
 - a. Each SLC and NAC circuit shall be electrically supervised for opens, shorts, and ground faults. Occurrence of fault shall activate system trouble circuitry, but shall not interfere with proper operation of other circuits.
 - b. Yellow "SYSTEM TROUBLE" LEDs shall light and system audible sounder shall steadily sound when trouble is detected in system. Failure of power, open or short circuits on SLC or NAC circuits, disarrangement in system wiring, failure of microprocessor or any identification module, or system ground faults shall activate this trouble circuit. Trouble signal shall be acknowledged by operating "TROUBLE ACKNOWLEDGE" switch. This shall silence sounder. If subsequent trouble conditions occur, trouble circuitry shall resound. During alarm, all trouble signals shall be suppressed with exception of lighting yellow "SYSTEM TROUBLE" LEDs.
9. Drift Compensation – Analog Smoke Sensors: System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment, including dust. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications and identify individual unit that requires maintenance.
10. Analog Smoke Sensor Test: System software shall automatically test each analog smoke sensor a minimum of 3 times daily. Test shall be recognized functional test of each photocell (analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor shall activate system trouble circuitry, display "Test Failed" indication, and identify individual device that failed.
11. Off-Premises Connection:
 - a. Connect via leased telephone lines to central station or remote station.
 - b. Connect via IP/Cellular Communicator to central station or remote station.
12. Network Annunciator: Each ILI-MB-E3 and associated display shall provide the required configured network annunciator. Annunciation shall default as regional annunciator with capability of selecting global annunciation to provide system-wide protection and Acknowledge, Silence, and Reset capabilities.
13. Redundant History Log: Each ILI-MB-E3 shall contain full 4100 event history log supporting local and network functions. If a main processor or network node is lost the entire log shall be accessible at any other Loop Interface board. This shall be demonstrated by removing power from INCC Command Center followed by extraction of history log from any loop driver location, including INCC Command Center or Transponder.
14. LEDs Indicator and Outputs: Each ILI-MB-E3 Loop Interface shall incorporate as a minimum the following diagnostic LED indicators:
 - a. Power: Green.
 - b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. General Trouble: Yellow.
 - e. Ground Fault: Yellow.

- f. Transmit: Green.
 - g. Receive: Green.
15. Auxiliary Power Outputs: Each ILI-MB-E3 Loop Interface shall provide the following supply outputs:
 - a. 24 VDC non-resettable, 1 amp. Maximum, power limited.
 - b. 24 VDC resettable, 1 amp. Maximum, power limited.
 16. Microprocessor: Loop interface shall incorporate 32-bit RISC processor. Isolated “watchdog” circuit shall monitor microprocessor and upon failure shall activate system trouble circuits on display. Microprocessor shall access system program for all control-by-event (CBE) functions. System program shall not be lost upon failure of both primary and secondary power. Programming shall support Boolean logic including AND, OR, NOT, TIME DELAY functions for maximum flexibility.
 17. Auto Programming: System shall provide for all SLC devices on any SLC loop to be pre-programmed into system. Upon activation of auto programming, only devices that are present shall activate. This allows for system to be commissioned in phases without need of additional downloads.
 18. Environmental Drift Compensation: System shall provide for setting Environmental Drift Compensation by device. When detector accumulates dust in chamber and reaches unacceptable level but yet still below allowed limit, control panel shall indicate maintenance alert warning. When detector accumulates dust in chamber above allowed limit, control panel shall indicate maintenance urgent warning.
 19. NON-FIRE Alarm Module Reporting: Non-reporting type ID shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display message at panel LDC. Activation of NON-FIRE point shall activate control by event logic, but shall not cause indication on control panel.
 20. 1-Man Walk Test:
 - a. System shall provide both basic and advanced walk test for testing entire fire alarm system. Basic walk test shall allow single operator to run audible tests on panel. All logic equation automation shall be suspended during test and while annunciators can be enabled for test, all shall default to disabled state. During advanced walk test, field-supplied output point programming shall react to input stimuli, such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch input. Advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device, and wiring operation/verification.
 - b. Test feature is intended to provide for certain random spot testing of system and is not intended to comply with requirements of testing fire alarm systems in accordance with NFPA 72, as it is impossible to test all functions and verify items such as annunciation with only 1 person.
 21. Signaling Line Circuits: Each ILI-MB-E3 module shall provide communication with analog/addressable (initiation/control) devices via 2 signaling line circuits. Each signaling line circuit shall be capable of being wired Class B, Style 4 or Class A, Style 6. Circuits shall be capable of operating in NFPA Style 7 configuration when equipped with isolator modules between each module type device and isolator sensor bases. Each circuit shall communicate with a maximum of 159 analog sensors and 159 addressable monitor/control devices. Unique 40-character identifier shall be available for each device. Devices shall be of the Velocity series with capability to poll 10 devices at a time with a maximum polling time of 2 seconds when both SLCs are fully loaded.
 22. Notification Appliance Circuits: 2 independent NAC circuits shall be provided on ILI-MB, polarized and rated at 2 amperes DC per circuit, individually over current protected and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class B, Style Y or Class A, Style Z.

23. Alarm Dry Contacts: Provide alarm dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system alarm occurs.
 24. Supervisory Dry Contacts: Provide supervisory dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system supervisory condition occurs.
 25. Trouble Dry Contacts: Provide trouble dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system trouble occurs
- H. Auxiliary Switch Module (ASM-16):
1. Each ASM-16 has 16 programmable push-button switches.
 2. Each push-button switch has 3 associated status LEDs (red, yellow, and green), configurable to indicate any combination of functions.
 3. Flexible switch configurations to allow flexible set-up of phone, speaker, and auxiliary function circuits.
 4. Insert label to identify function of each switch and LEDs combination.
 5. Provide capability to communicate with up to 16 ASM-16 modules locally, up to 3,000 feet from INCC Command Center.
 6. Specialty modules that only perform 1 task such as speaker, phone, or auxiliary shall not be acceptable.
- I. Microphone Assembly: Include the following items:
1. Mounting cabinet which occupies 1 module location on inner door of INCC.
 2. Interconnect cable for connection of microphone to INI-VG.
 3. 1 noise canceling microphone with push-to-talk button.
- J. Addressable Node Expander (ANX):
1. Addressable Node Expander shall provide interconnection between the Fire Alarm Control Panel networks.
 2. ANX-MR-FO (Addressable Node Expander Multi-Ring with Fiber Optic connectors) and ANX-MR-UTP (Addressable Node Expander Multi-Ring with Fiber Optic and Twisted Pair connectors) shall expand the E3 Series network from 64 nodes to 122 nodes. ANX-SR (Addressable Node Expander Single Ring) will function in single 64 node systems.
 3. ANX shall provide a Ethernet Port for use in Systems Integration and for use with Emergency Communication System (ECS) functions. The Ethernet port may also be used to communicate with a graphic interface software.
- K. Network Repeater Module (RPT-E3):
1. Intelligent Network Interface shall provide interconnection and protection of remote INCC Command Centers and Transponders. Repeater shall regenerate and condition token passing, 625 K baud signal between units. Repeater shall be available in wire, or wire/fiber configurations as determined by field conditions.
 2. Interface shall have jumper to allow selection of ground detection of wiring when used in wire mode. Interface shall have integral LEDs to display current status of board.
 3. Fiber configurations shall use:
 - a. Multi-Mode ST-type connectors with a maximum attenuation of 8db with 62.5/125 micron cable.
 - b. Single-Mode LC-style connector with a maximum attenuation of 30db with 9/125 Micron cable.

2.4 INTELLIGENT NETWORK TRANSPONDER (INX)

- A. System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. INX shall receive, transmit, and regenerate voice and data over single pair of wire or fiber optic cable.
- B. INX shall provide full multi-channel distributed voice messaging, with integrated switching amplification, and SLC and extended phone riser. INX shall communicate with network system in true peer-to-peer fashion operating at 625 K baud over any combination of fiber or wire media. INX shall consist of the following units and components.
- C. System Cabinet: System cabinet shall be surface or semi-flush mounted with texture finish and shall consist of 4 parts, back box, back plate, inner door, and outer door. System cabinet houses INI-VG, PM-9 power supply, up to 4 - AM50, microphone, and related circuitry.
- D. Intelligent Network Interface Voice Gateway (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall include the following features as a minimum:
 - 1. Network interface operating at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 total INCC, INX, and E3 and S3 control panels in peer-to-peer fashion.
 - 2. Signaling Line Circuit (SLC): INI-VG shall generate local SLC to communicate with and control up to 16 AOM-TEL modules and 32 AOM-2S or AOM-MUX circuits for fire phone interfacing and additional split-speaker circuits.
 - 3. RS-485: Provide capability to communicate with up to 16 ASM-16 modules, when used in INX mode up to 3,000 feet.
 - 4. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIME DELAY functions.
 - 5. Voice Generation: INI-VG shall incorporate all processing to allow for 16 distinct pre-recorded messages used in priority fashion with message 1 as highest priority. Total length for 1 to 16 messages shall be up to 3 minutes.
- E. Power Supply Module (PM-9): PM-9 power supply shall supply all power necessary under normal and emergency conditions. Power supply shall provide capacity to charge up to 55 amp-hour batteries while under full load. Technology used shall be of power-saving switching configuration, eliminating need of stepping transformer.
- F. Audio Amplifier (AM-50): Include as a minimum, the following features:
 - 1. 50-watt switching audio amplifier:
 - a. AM-50-25 amplifier produces 25V_{RMS} at 50 watts digital audio output.
 - b. AM-50-70.7 amplifier produces 70V_{RMS} at 50 watts digital audio output.
 - 2. Individually addressable speaker circuits, each with capability of handling part or all of 50-watt supplied power.
 - 3. Power shall be 24 VDC supplied via terminal block from local PM-9 power supply.
 - 4. Ability to select from 1 of 16 pre-programmed messages in INI-VG, and paging from locally or from INCC Command Center.
 - 5. Back-up amplification configurable so 1 AM-50 can perform back-up or 3, or perform 1-to-1 back-up if configured to do so in programming.
 - 6. Status LEDs to indicate normal operation and trouble condition.

2.5 PRINTERS

- A. Printers: Automatic type, printing code, time, date, location, category, and condition.
 - 1. Provide hard-copy printout of all changes in status of system and time-stamp such printouts with current time-of-day and date.

2. Standard carriage with 80 characters per line.
3. Use standard pin-feed paper.
4. Enclose in separate enclosure suitable for placement on desktop or table.
5. Communicate with control using interface complying with EIA-232-D.
6. Power: 120 VAC at 60 Hz.

2.6 SUPPLEMENTAL NOTIFICATION APPLIANCE CIRCUIT (HPFF8)

- A. Supplemental Notification Appliance Circuit (HPFF) shall be Model HPFF8 offering up to 8.0 amps (8.0 amps continuous) of regulated 24-volt power. HPFF shall include the following features:
1. Integral Charger: Charge up to 18.0 amp-hour batteries and support 60-hour standby.
 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 3. Surface-mount back box.
 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 5. Power limited circuitry in accordance with applicable UL standards.
 6. Operates as sync follower or a sync generator.

2.7 SYSTEM PERIPHERALS - Velociti

- A. Addressable Devices – General:
1. Provide address-setting means using rotary-decimal switches.
 2. Use simple to install and maintain decade-type (numbered 0 to 15) address switches by using standard screwdriver to rotate 2 dials on device to set address. Devices which use binary address set via dipswitch packages, handheld device programmer, or other special tools for setting device address shall not be acceptable.
 3. Detectors: Analog and addressable. Connect to fire alarm control panel's Signaling Line Circuits.
 4. Addressable Thermal and Smoke Detectors: Provide 2 status LEDs. Both LEDs shall flash under normal conditions, indicating detector is operational and in regular communication with control panel, and both LEDs shall be placed into steady illumination by control panel, indicating alarm condition has been detected. If required, flashing mode operation of detector LEDs can be programmed off via fire control panel program.
 5. Fire Alarm Control Panel: Permit detector sensitivity adjustment through field programming of system. Sensitivity can be automatically adjusted by panel on time-of-day basis.
 6. Using software in INCC Command Center, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. Detectors shall be listed by UL as meeting calibrated sensitivity test requirements of NFPA 72, Chapter 7.
 7. Detectors shall be ceiling-mounted and shall include separate twist-lock base with tamper-proof feature.
 8. Following bases and auxiliary functions shall be available:
 - a. Standard base with remote LED output.
 - b. Sounder base rated at 85 dBA minimum.
 - c. Intelligent Addressable Sounder base rated at 75 dBA minimum.
 - d. Form-C relay base rated 30 VDC, 2.0 A.
 - e. Isolator base.
 9. Detectors shall provide test means whereby they will simulate alarm condition and report that condition to control panel. Such test shall be initiated at detector itself by activating magnetic switch or initiated remotely on command from control panel.

10. Detectors shall store internal identifying type code that control panel shall use to identify type of device (ION, PHOTO, THERMAL).
- B. Addressable Manual Stations (MS-7AF):
 1. Manual Fire Alarm Stations: Non-code, non-break glass type, equipped with key lock so they may be tested without operating handle.
 2. Operated Station: Visually apparent, as operated, at a minimum distance of 100 feet (30.5 m) from front or side.
 3. Stations shall be designed so after actual activation, they cannot be restored to normal except by key reset.
 4. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters, 1.75 inches (44 mm) or larger.
 5. Addressable manual stations shall, on command from control panel, send data to panel representing state of manual switch and addressable communication module status.
- C. Intelligent Thermal Detectors (ATD-RL2F): Intelligent addressable devices rated at 135 degrees F (58 degrees C) and have rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. Connect via 2 wires to fire alarm control panel signaling line circuit.
- D. Intelligent Photoelectric Smoke Detectors (ASD-PL2F): Use photoelectric (light-scattering) principal to measure smoke density and shall, on command from control panel, send data to panel representing analog level of smoke density.
- E. Intelligent Ionization Smoke Detectors (ASD-IL2F): Use dual-chamber ionization principal to measure products of combustion and shall, on command from control panel, send data to panel representing analog level of products of combustion.
- F. Intelligent Multi-Criteria Acclimating Detectors (MCS-ACCLIMATE2F):
 1. Addressable device designed to monitor a minimum of photoelectric and thermal technologies in single-sensing device. Include ability to adapt to its environment by utilizing built-in microprocessor to determine its environment and choose appropriate sensing settings. Allow wide sensitivity window, with no less than 1 to 4 percent per foot obscuration. Utilize advanced electronics that react to slow smoldering fires and thermal properties within single sensing device.
 2. Microprocessor: Capable of selecting appropriate sensitivity levels based on environment type it is in, such as office, manufacturing, or kitchen, and then have ability to automatically change setting as environment changes, as when walls are moved or as occupancy changes.
 3. Intelligent multi-criteria detection device shall include ability to combine signal of thermal sensor with signal of photoelectric signal to react hastily in event of fire situation. Include inherent ability to distinguish between fire condition and false alarm condition by examining characteristics of thermal and smoke sensing chambers and comparing them to database of actual fire and deceptive phenomena.
- G. Intelligent Laser Detectors (ASD-LS): Sensor device designed to use laser diode similar to way photoelectric sensor uses LEDs inside of sensing chamber. Detector design shall allow wide sensitivity window, with no less than 0.2 to 4 percent per foot obscuration. Detector shall be used as indicated in special application clean-room-type environments only.
- H. Intelligent 4 Element Multi-Criteria Detectors (MCS-4-WARN):
 1. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO)

- sensor, a daylight-filtered infrared sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
2. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.
 3. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
 4. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.
- I. Intelligent Fire/Carbon Monoxide Detectors (MCS-COF):
1. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
 2. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.
 3. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
 4. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning
 5. The MCS-COF Photo/CO Detector shall be used with the B200S Intelligent Sounder Base.
- J. Intelligent Duct Smoke Detector Base (DNR, DNRW):
1. In-Duct Smoke Detector Housing: Use ASD-PL2F intelligent photoelectric detector, ASD-PL2FR intelligent remote test photoelectric detector or ASD-IL2F intelligent ionization detector, which provides continuous analog monitoring and alarm verification from panel.
 2. When sufficient smoke is sensed, alarm signal is initiated, and appropriate action taken to shut down or change over air handling systems to help prevent rapid distribution of toxic smoke and fire gases throughout areas served by duct system.
 3. Duct Smoke Detectors Mounted Above Ceiling or Otherwise Obstructed from Normal View: Provide an (RTS151KEY) Remote test station accessory, designed to test a remotely located Intelligent Duct Smoke detector with remote alarm indicator.

4. Each Detector: Install in either supply side or return side duct in accordance with local mechanical code.
 5. DST Sampling Tube
 - a. No tools needed for installation or removal
 - b. Installs/removes from front or back of detector
 - c. Available in 1 ft, 1.5ft, 3 ft, 5 ft, and 10 ft lengths
- K. Addressable Dry Contact Monitor Modules (AMM-2F):
1. Provide to connect 1 supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in standard deep electrical box.
 3. IDC Zone: Suitable for Style B operation.
- L. Addressable Dry Contact Monitor Modules (AMM-4F):
1. Provide to connect 1 supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in 4-inch (102-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zone: Suitable for Style D or Style B operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- M. Addressable Dry Contact Monitor Modules (AMM-2IF):
1. Provide to connect 2 supervised IDC zones of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zones: Suitable for Style B operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- N. Addressable Two Input and Two Output Modules (AMM-2RIF):
1. Provide two isolated sets of Form-C contacts, which operate as a single pole double throw switch. The module shall allow the control panel to switch these contacts on command. The module shall not provide supervision for the notification appliance circuit (NAC). Module shall have both normally open and normally closed connections available for field wiring. Two input modules shall connect two supervised initiating device circuit (IDC) or zone of conventional alarm initiating devices (any normally open dry contact device) to the fire alarm control panel signaling line circuit (SLC) Loop.
 2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zones: Suitable for Style B operation.
 4. LEDs: Four LEDs that are controlled by the panel to indicate status of each input and output. Coded signals, transmitted from the panel, can cause the LED to blink, latch on, or latch off. Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- O. Addressable Dry Contact Monitor Modules (MMI-10F):
1. Provide to connect 10 supervised Style B IDC zones or 5 supervised Style D IDC zones of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
 3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- P. 2-Wire Detector Monitor Modules (AMM-4SF):
1. Provided to connect 1 supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to optional surface-mounted back box.
 3. IDC Zone: Wired for Class A or B (Style D or Style B) operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- Q. 2-Wire Detector Monitor Modules (MMI-6SF):
1. Provided to connect 6 supervised Class B IDC zones of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
 2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
 3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- R. Addressable Control Modules (AOM-2SF):
1. Provide to supervise and control operation of 1 conventional NAC of compatible, 24-VDC powered, polarized audio/visual notification appliances or UL-listed polarized relays for fan shutdown and other auxiliary control functions.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
 3. Control Module NAC: Wire for Style Z or Style Y (Class A/B) with up to 1 amp of inductive signal or 2 amps of resistive signal operation. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
 4. Audio/Visual Power: Provide by separate supervised power circuit from main fire alarm control panel or from supervised, UL-listed remote power supply.
- S. Addressable Control Modules (MMO-6SF):
1. Provide to supervise and control operation of 1 conventional NAC of compatible, 24-VDC powered, polarized audio/visual notification appliances or UL-listed polarized relays for fan shutdown and other auxiliary control functions.
 2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
 3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
 4. Control module NAC: Wire for Style Z or Style Y (Class A/B) with up to 1 amp of inductive signal or 2 amps of resistive signal operation. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
 5. Audio/Visual Power: Provide by separate supervised power circuit from main fire alarm control panel or from supervised, UL-listed remote power supply.
- T. Addressable Relay Modules (AOM-2RF):
1. Available for HVAC control and other building functions. Relay shall have 2 Form C sets of contacts that operate in tandem and are rated for a minimum of 2.0 amps resistive or 1.0 amps inductive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
- U. Addressable Relay Modules (MMO-6RF):
1. Available for HVAC control and other building functions. Relay shall be Form C and rated for a minimum of 2.0 amps resistive or 1.0 amps inductive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to

ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.

2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.

V. Isolator Modules (M500X):

1. Provide to automatically isolate wire-to-wire short circuits on SLC Class A or Class B branch. Isolator module shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. At least 1 isolator module shall be provided for each floor or protected zone of building. No more than 25 devices shall be connected to 1 isolator module.
2. If wire-to-wire short occurs, isolator module shall automatically open-circuit (disconnect) SLC. When short-circuit condition is corrected, isolator module shall automatically reconnect isolated section.
3. Does not require address-setting, and its operations shall be totally automatic. Not necessary to replace or reset isolator module after normal operation.
4. Mount in standard 4-inch (101.6-mm) deep electrical box or in surface-mounted back box.
5. Single LED: Flash to indicate isolator is operational and illuminate steadily to indicate short-circuit condition has been detected and isolated.

2.8 SYSTEM PERIPHERALS – E3 SERIES

A. Auxiliary Switch Module (ASM-16):

1. Each ASM-16 has 16 programmable push-button switches.
2. Each push-button switch has 3 associated status LEDs (red, yellow, and green), configurable to indicate any combination of functions.
3. Flexible switch configurations to allow auxiliary functions.
4. Insert label to identify function of each switch and LEDs combination.
5. Provide capability to communicate with up to 16 ASM-16 modules locally, or up to 3,000 feet from the Control Panel.

B. Speakers:

1. Operate on 25 VRMS or 70.7 VRMS with field-selectable output taps from 0.5 to 2.0 watts.
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m).
3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.

C. Strobes:

1. Compliance: ADA and UL 1971.
2. Maximum Pulse Duration: 0.2 second.
3. Strobe Intensity: UL 1971.
4. Flash Rate: UL 1971.
5. Strobe Candela Rating: Determine by positioning selector switch on back of device.

D. Speaker/Strobes:

1. Operate on 25 VRMS or with field-selectable output taps from 0.5 to 2.0 watt
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m).

3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
 4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.
 5. Audibility: NFPA 72.
 6. Maximum Pulse Duration: 0.2 second.
 7. Strobe Intensity: UL 1971.
 8. Flash Rate: UL 1971.
 9. Strobe Candela Rating: Determine by positioning selector switch on back of device
- E. Document Box (Space Age Pt # SSU00685):
1. 18 gauge steel lockable red enclosure
 2. 1" High Lettering "FIRE ALARM DOCUMENTS"
 3. Integrated 4 GB USB B Connector Flash Drive to store fire alarm software
 4. 12' X 13" x 2 ¼" deep

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive fire alarm system.
1. Notify Architect of conditions that would adversely affect installation or subsequent use.
 2. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install fire alarm system in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicated on the Drawings.
- B. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas.
- C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.
- D. Flush-mount fire detection and alarm system devices, control panels, and remote annunciators in finished areas. Flush-mount or surface-mount fire detection and alarm system devices, control panels, and remote annunciators in unfinished areas.
- E. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, not more than 48 inches, above finished floor measured to operating handle.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide service of competent, factory-trained technician authorized by manufacturer to technically supervise and participate during pre-testing and acceptance testing of system.
- B. Testing:
1. Conduct complete visual inspection of control panel connections and test wiring for short circuits, ground faults, continuity, and insulation before energizing cables and wires.

2. Close each sprinkler system control valve and verify proper supervisory alarm at Control Panel.
 3. Verify activation of flow switches.
 4. Open initiating device circuits and verify that trouble signal actuates.
 5. Open signaling line circuits and verify that trouble signal actuates.
 6. Open and short notification appliance circuits and verify that trouble signal actuates.
 7. Ground initiating device circuits and verify response of trouble signals.
 8. Ground signaling line circuits and verify response of trouble signals.
 9. Ground notification appliance circuits and verify response of trouble signals.
 10. Check installation, supervision, and operation of intelligent smoke detectors.
 11. Introduce on system each of the alarm conditions that system is required to detect. Verify proper receipt and proper processing of signal at Control Panel and correct activation of control points.
 12. Consult manufacturer's manual to determine proper testing procedures when system is equipped with optional features. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality, and similar.
- C. Acceptance Testing:
1. Before installation shall be considered completed and acceptable by AHJ, a complete test using as a minimum, the following scenarios shall be performed and witnessed by representative approved by Engineer. Monitoring company and/or fire department shall be notified before final test in accordance with local requirements.
 2. Contractor's job foreman, in presence of representative of manufacturer, representative of Owner, and fire department shall operate every installed device to verify proper operation and correct annunciation at control panel.
 3. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.
 4. When testing has been completed to satisfaction of both Contractor's job foreman and representatives of manufacturer and Owner, a notarized letter co-signed by each attesting to satisfactory completion of said testing shall be forwarded to Owner and fire department.
 5. Leave fire alarm system in proper working order and, without additional expense to Owner, replace defective materials and equipment provided within 1 year (365 days) from date of final acceptance by the owner.

3.4 DEMONSTRATION

- A. Provide instruction as required for operating fire alarm system.
- B. Provide hands-on demonstrations of operation of fire alarm system components and functions.

END OF SECTION

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SECTION 31 1000

SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to site preparation, unless otherwise noted. This section applies to:
 - 1. Surface and subsurface demolition.
 - 2. Backfilling of excavations and depressions.
 - 3. Coordination, demolition and/or relocation of existing utilities.
 - 4. Prior to start of demolition of facilities, shut-off, disconnect, cut, and cap where required, underground utility services to facilities.
 - 5. Removal of A.C. pavement driveway and concrete pavement, concrete pads, and A.C. curbing.
 - 6. Removal of cyclone wire, wood fences and barricades.
 - 7. Removal of storm drainage piping, catch basins, and manholes.
 - 8. Removal of vegetation and trees as specified herein.
- B. Contractor shall provide labor, material and equipment required for demolishing, cutting, removing and disposing of existing construction as designated and shown on the drawings for the following as required, unless otherwise noted.
- C. Coordinate all work with capping or sealing of existing utilities.
- D. Related Sections:
 - 1. Section 31 2200 – EARTHWORK AND GRADING.
 - 2. Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING.

1.2 SUBMITTALS

- A. Comply with requirements of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Submit copies of all permits and certificates required for the project to the District's Representative, for record purposes.
- C. Permits and notices authorizing demolition.
- D. Submit copy of letters or certificates of severance of utilities services from the affected agencies or utilities.
- E. Submit copies of proposed haul route(s) from the demolition worksite to an authorized disposal site as approved by authority having jurisdiction.
- F. Submit copy of permit for transport and disposal of debris.
- G. Make arrangements of disposing of waste and excess materials at a legally licensed landfill/disposal facility outside worksite and pay cost thereof.
- H. Photograph existing conditions of existing structure surfaces, equipments, and adjacent improvements that might be misconstrued as damage related to removal operations. File photographs with District's Representative prior to start of work.

- I. Submit proposed dust control measures and a copy of approved permit.
- J. Submit proposed noise control measures and a copy of approved permit.
- K. Work Schedule: Submit a proposed schedule of work items to be performed, and a description of how the work is to be accomplished, for the review by the District's Representative.
- L. Report of inspections conducted with the District's Representative and Architect both before and after performing work.

1.3 QUALITY ASSURANCE

- A. Comply with the following Standards: American National Standards Institute, Inc. "American National Standard Safety Requirements for Demolition" (ANSI A10.6 and A10.8).
- B. Regulatory Agencies:
 - 1. Comply with rules and regulations of State of California, California Code of Regulations, Title 8, Industrial Relations, Chapter 4, Subchapter 4, "Construction Safety Order."
 - 2. Comply with applicable local and state agencies having jurisdiction.
 - 3. Comply with governing EPA notification regulations.
- C. Secure all required Permits or Certificates for demolition or discontinuance of utilities, prior to beginning the work.

1.4 PROJECT CONDITIONS

- A. District's Representative assumes no responsibility for actual condition of the site to be altered.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by District's Representative as far as practical.
- B. Disposal of Existing Improvements:
 - 1. All materials indicated to be removed shall become the property of the Contractor; dispose of these outside the project site.
 - a. Do not dispose of removed materials to the general public by sale, gift or in any other manner at the Site.
 - b. These provisions shall not be construed as limiting or prohibiting sale or disposal of such materials at the Site to duly licensed Contractors or material suppliers, provided materials are removed from the construction site by the Contractor.
 - 2. All removal of debris from the site, including removal of inventory to site of storage, is part of this Contract and shall be done by Contractor's employees and no others.
- C. Salvage and Reuse:
 - 1. Where units or items of existing work are designated in Section 01 3113 - PROJECT COORDINATION or Contract Plans to be removed and reused in the new work or are to become salvage, remove such units or items carefully.
 - a. Use tools and methods that will not damage such units or items.
 - b. Protect underlying or adjoining work from damage.
 - c. Salvaged items shall be cleaned by the Contractor.
 - 2. Recycle AC pavement and Class II AB where practical.

3. Recycle concrete where practical.
 4. Items indicated to be salvaged shall be removed carefully, cleaned, and returned to the District. Coordinate with the District's Representative.
- D. Protection:
1. Erect and maintain temporary bracing, shoring, lights, and barricades, except construction barricades for subsequent new construction, warning signs, and guards necessary to protect public, the District's employees, finishes, improvements to remain and adjoining property from damage, all in accordance with applicable regulations.
 2. Wet down areas affected by this work as required to prevent dust and dirt from rising.
- E. Scheduling:
1. Coordinate with the District's Representative in scheduling noisy or dirty work.
 2. Schedule work at the District's convenience to cause minimal interference with the District's normal operations.
 3. Jack hammering will be allowed only during the following time periods 7:00 AM - 6:00 PM on weekdays.
- F. Traffic Circulation: Ensure minimum interference with roads, streets, driveways, sidewalks, and adjacent facilities.
1. Do not close or obstruct public thoroughfares without first obtaining the required permit or permission of the responsible jurisdiction.
 2. Where closing of a vehicular or pedestrian traffic circulation route is necessary, provide adequate directional signs to minimize the potential for confusion.
 3. Maintain emergency access routes and coordinate any interruptions with local entities.
 4. Provide pedestrian paths as necessary and coordinate with the District.

PART 2 – PRODUCTS

2.1 PIPE ABANDONMENT MATERIALS

- A. Slurry cement backfill conforming to Caltrans Standard Specification 19-3.02E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas affected by work of this Section and verify following:
1. Disconnection of utilities as required.
 2. That utilities serving occupied portions of buildings on and off the site will not be disturbed.
 3. Removal by the District of the District's personal property, movable furniture and equipment items not designated for relocation.
- B. Document video and/or photograph, as necessary, existing items to remain that are damaged and submit photographs to District.
- C. Where existing conditions conflict with representations of the Contract Documents, notify the District's Representative and obtain clarifications. Do not perform work affecting the conflicting conditions until clarification of the conflict is received.

3.2 PREPARATION

- A. Verify that the area to be demolished or removed has been vacated, or adequate space made available to perform the work.
- B. Arrange for, and verify, termination of utility services to include removing meters and capping of lines.
- C. Lay out cutting work at Job Site and coordinate with related work for which cutting is required.

3.3 DEMOLITION

- A. If known or suspected hazardous materials are encountered during operations, stop operations immediately and notify the District's Representative.
- B. Perform work in accordance with ANSI A10.6-1969 unless otherwise noted.
- C. Provide noise and dust abatement as required to prevent contamination of adjacent areas.
- D. Remove all materials not designated as salvage, in their entirety.
- E. Remove building foundations in their entirety, unless otherwise indicated on the plans.
- F. Fill voids in the land left by the removal of existing structures as follows:
 - 1. In accordance with the requirements of Section 31 2200 – EARTHWORK AND GRADING. Grade finished remaining surface to the contours shown, or if not shown, to match the existing natural contours.
- G. Lower, or remove, heavy structural framing members by hoist or crane.
- H. Concrete and Masonry:
 - 1. Demolish concrete and masonry in sections, less than 3 feet in any direction.
 - 2. Method of cutting shall be limited to saw cutting and torch.
- I. If unknown items such as human remains are encountered during operations, stop operations immediately and notify the District's Representative.
- J. The District's Representative will provide a list of any items to be stockpiled for future use. Stockpile location will be a site on campus determined by the District's Representative.

3.4 DEMOLITION AND REMOVAL OF AC PAVEMENT:

- A. Saw cut pavement at edge of demolition area.
- B. Break pavement and remove.
- C. Remove any base material, gravel, and/or any other non-native soil.

3.5 CUTTING

- A. Make new openings neat.

- B. Do not cut or alter structural members and any utilities including appurtenances unless indicated to do so in the Construction Documents or written approval is received from the Architect.
- C. Take care not to damage reinforcing or structural steel scheduled to remain in place.
- D. Concrete: Cut new openings in concrete by coring and saw cutting. Saw run-bys will not be permitted.

3.6 PREPARATION FOR NEW FINISH WORK

- A. Where demolished surfaces are scheduled to receive new finishes, Contractor shall restore such substrate to a condition ready to receive the scheduled new finishes, including grinding or leveling.

3.7 UTILITY REMOVAL:

- A. Where utility removal is shown on the plans, excavate to expose existing utility, demolish and remove section of pipe or conduit indicated. Cap section of pipe or conduit to remain. Mark end of utility with stake, rebar, or Surveyor's marker.
- B. Provide thrust block or other mechanical restraint where dead end is created on pressurized pipe systems. Thrust blocks shall be per NFPA 24 Standards.
- C. Included in demolition are any appurtenances, including but not limited to valves, valve boxes, and irrigation system components.
- D. Backfill trench in accordance with requirements of Section 31 23 33 – TRENCHING, BACKFILLING, AND COMPACTING.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning of demolished materials on-site is prohibited. Burning may be performed off-site of District's property provided it is done in a legal manner.

3.9 FIELD QUALITY CONTROL

- A. The District's Representative and Architect will accompany the Contractor before and after performance of work to observe physical condition of existing structures or improvements involved.

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SECTION 31 1413

TOPSOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Salvaging and stockpiling topsoil

1.2 RELATED SECTIONS

- A. Section 01 5639 – TEMPORARY TREE AND PLANT PROTECTION
- B. Section 31 1000 – SITE PREPARATION AND DEMOLITION
- C. Section 31 2000 – EARTHWORK AND GRADING
- D. Section 32 9110 – TOPSOIL

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.

1.5 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 32 9110 TOPSOIL. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 5639 TEMPORARY TREE AND PLANT PROTECTION.
- C. Protect existing site improvements to remain from damage during construction.
- D. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TOPSOIL STRIPPING

- A. Remove shrubs, sod, and grass before stripping topsoil.
- B. Use of chemicals and pesticides shall not be allowed.
- C. Topsoil within the limits of the project shall be salvaged prior to beginning excavating, fill or hauling, operations.
- D. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- E. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover stockpiles to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within tree protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

F. Salvaged topsoil exceeding the quantity required under the contract shall be disposed of at contractor's expense.

3.3 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

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SECTION 31 2000

EARTHWORK AND GRADING

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section describes general requirements, products, and methods of execution relating to on-site earthwork. Any work within the public right-of-way shall be constructed to the standards of the City of Livermore and State of California Department of Transportation. Work includes, but is not limited to, the following:
1. Grading.
 2. Material.
 3. Excavation.
 4. Filling and backfilling.
 5. Soil Sterilant.
 6. Termiticide.
- B. Provide labor, material and equipment and services necessary to complete the excavations, re-compaction and finish grading as specified and indicated on Drawings.
1. Obtain permit from local authorities.
 2. Provide surveying for grading operations.
 3. Provide shoring design.
 4. Provide dewatering operations.
 5. Provide site grading, cut, fill and finish.
 6. Provide excavation and backfill for filling construction, including trenches within building lines.
 7. Preparation for subgrade for building slabs, walks, pavements, and landscaping.
 8. Provide distribution of stockpiled topsoil.
 9. Provide sub-base course for walks and pavements.
 10. Provide engineered fills for building slabs and foundations.
 11. Provide sand and gravel for capillary break/moisture barrier under building slabs.
 12. Provide sub-surface drainage backfill for walls and trenches.
- C. The work includes removal and legal disposal off the site of debris, rubbish and other materials resulting from clearing and grubbing operations.
- D. Work specified in Related Sections:
1. Section 31 1000 – SITE PREPARATION AND DEMOLITION.
 2. Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING.
 3. Section 34 4727 – BIORETENTION

1.2 DEFINITIONS:

- A. Select Fill:
1. Soil or soil-rock material approved by District's Representative used by the Contractor in order to raise grades or to backfill excavations.
 2. The District's Testing Agency will make sufficient tests and/or observations for the purpose of issuing a written statement that material meets or exceeds the specification requirements.
- B. On-site Material: Soil or earth material obtained from required on-site excavation.

- C. Excavation: Consists of the removal of material encountered to subgrade elevations and the re-use or disposal of materials removed.
- D. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below sub-base, drainage fill, rock base course, or topsoil materials.
- E. Import Material: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- F. Base Course: The layer placed between the sub-base and surface pavement in a paving system.
- G. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure American Society for Testing and Materials (ASTM) D1557.
- H. Overexcavation: Removal of material below required subgrade elevations.

1.3 SUBMITTALS:

- A. Comply with provisions of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Product Data: Manufacturer's literature and data, including, where applicable, capacity, labels, or other markings on equipment made to the specified standards for materials, for the following:
 - 1. Imported materials.
 - 2. Class II aggregate base (Caltrans Section 26).
 - 3. Soil Sterilant.
 - 4. Termiticide.
 - 5. Cement Treatment.
 - 6. Geotextiles.
 - 7. Subdrainage Pipe.
- C. Test Reports: Submit the following reports for import material directly to Architect from the Contractor's testing services:
 - 1. Test reports on borrow material.
 - 2. Density test reports.
 - 3. One optimum moisture-maximum density curve for each type of soil encountered.
 - 4. Not used.
 - 5. Not used.
 - 6. Soil percolation rate test for soils to be used in storm water treatment zones.
- D. Shoring Design: Where shoring is required by State Law or Contractor shall provide necessary design, provide proposed excavation shoring method for review prior to commencement of excavation requiring shoring. Include the following information:
 - 1. Basic design assumptions.
 - 2. Design Calculations.
 - 3. Describe materials or shoring system to be used.
 - 4. Indicate whether or not any components will remain after filling or backfilling.
 - 5. The shop drawings for the proposed shoring system.
 - 6. Coordinate with the Construction Documents and identify any proposed modifications or deviations.
 - 7. Certification of the above by a registered professional civil or structural engineer licensed by the State of California.

8. Submittal will be reviewed for general conformance with project plans, but no review of calculations will be provided.
- E. Dewatering Plan: Based upon site surface and subsurface conditions, including available geotechnical and hydrological data, provide a system to perform the following:
 1. Lower the ground water level below bottom of excavation.
 2. Relieve the hydrostatic pressure below the subgrade to prevent uplift.
 3. Prevent surface drainage from accumulating within work area.
 4. Legally discharge and dispose of excess water.
 5. Submit description of basic components of proposed dewatering system and its planned method of operation.
- F. Samples:
 1. 20-lb. samples sealed in air-tight containers, of each proposed fill and backfill soil material from on-site or borrow sources. Provide to Geotechnical Engineer as requested.
 2. 20-lb samples sealed in air tight containers of specialty soils for submission to a plant and soil testing facility for analysis. Include perc test and sieve analysis.
- G. Pad Certification
 1. Submit a pad certification stamped by a California Licensed Land Surveyor.
- H. Storm Water Pollution Prevention / Erosion Control Plans/Water Pollution Control Plans
- I. Permit/Notice of Intent (N.O.I.), for discharge of storm run-off from the construction site.
- J. Haul Routes.

1.4 ASSURANCE:

- A. Requirements of Regulatory Agencies:
 1. Comply with State of California Business and Transportation Agency, California Department of Transportation (CDT, Caltrans) "Standard Specifications" (Caltrans Standard Specification).
 2. Comply with State of California Code of Regulations (CCR).
 3. Comply with State of California Construction Safety Orders, Latest Edition (CAL/OSHA).
 4. City of Livermore Department of Public Works, Standards and Specifications and Drawings, latest edition.
 5. BCDC, ACOE, Fish and Wildlife, if applicable.
- B. Soil Testing:
 1. District will engage a geotechnical testing agency, to include testing soil materials proposed for use in the work and for quality control testing during excavation and fill operations.
 2. Test results will be distributed in compliance with Section 01 4500 – QUALITY CONTROL.
- C. Codes and Standards:
 1. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
 2. Statewide General Permit to Discharge Storm Water associated with construction activity.
 3. The project Storm Water Pollution Prevention and Monitoring Plan.

- D. Comply with the latest editions of the following Standards and Regulations:
1. American Society for Testing and Materials (ASTM):
 - a. Concrete Aggregates.
 - b. C125: Standard Terminology Relating to Concrete and Concrete Aggregates.
 - c. C136: Sieve Analysis of Fine and Coarse Aggregates.
 - d. C566: Total Evaporable Moisture Content of Aggregate by Drying.
 - e. D421: Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
 - f. D422: Particle Size Analysis of Soil.
 - g. D854: Specific Gravity of Soils.
 - h. D1556: Density of Soil by the Sand Cone Method.
 - i. D1557: Laboratory Compaction Characteristics of Soil Using Modified Effort
 - j. D2216: Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
 - k. D2487: Classification of Soils for Engineering Purposes.
 - l. D2922: Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - m. D2937: Density of Soil in Place by Drive Cylinder Method.
 - n. D3017: Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - o. D4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 2. California Code of Regulations, Title 24, Part 2 - Basic Building Regulations, Chapter 24 - Excavations, Foundations, and Retaining Walls.
 3. California Department of Transportation (Caltrans) Standard Specifications:
 - a. Section 10: Watering.
 - b. Section 18: Dust Palliatives.
 - c. Section 19: Earthwork.
 4. CAL/OSHA, Title 8.
 5. City of Livermore Standard Plans and Specifications
 6. Other authorities having jurisdiction
- E. Geotechnical Engineering Services:
1. Geotechnical Engineer shall be provided by the District or Contractor, as the District's Representative to observe grading observations during preparation offsite, excavation, and compaction of fill materials.
 2. Make visits to site to familiarize him generally with progress and quality of work.
 3. Make field observations and tests to enable him to form opinions regarding adequacy of site preparation, acceptability of fill materials and extent to which earthwork construction and relative compaction comply with specifications requirements.
 4. Examine conditions exposed in foundation excavations.
- F. Site Information:
1. Geotechnical Investigation Reports are available for examination by Contractor.
 2. Additional soil borings and other exploratory operations may be made by Contractor at no cost to the District. Submit proposed boring locations for review prior to performing the work.
- G. Contractor Qualifications:
1. Have successfully installed structural soil mixes similar to the quality specified for a period of not less than 5 years.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Protect materials of this section before, during and after installation; objects designated to be retained; and the installed work of other trades.

- B. In the event of damage to any of these items, immediately make repairs or replacements necessary to the acceptance of the District's Representative and at no additional cost to the District.
- C. Comply with provisions of Section 01 5000 – TEMPORARY FACILITIES where necessary to control dust and noise on and near the work caused by operations during performance of the Work.

1.6 PROJECT CONDITIONS:

- A. Site Information: Review geotechnical report titled Geotechnical Evaluation & Geologic Hazards Assessment by Ninyo & Moore (dated March 31,2020), noting:
 - 1. The character of the material to be excavated or used for subgrade is not necessarily as indicated.
 - 2. Ground water elevations indicated are those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- B. Environmental Requirements:
 - 1. Comply with the project SWPPP.
 - 2. When unfavorable weather conditions necessitate interrupting filling and grading operations, prepare areas by compaction of surface and grading to avoid collection of water.
 - 3. Provide adequate temporary drainage to prevent erosion.
 - 4. After interruption, reestablish compaction specified in last layer before resuming work.
 - 5. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the District.
 - 6. Protect existing streams, ditches and storm drain inlets from water-borne soil by means of straw bale dikes, filter fiber dams, or other methods.
- C. Protections of open excavations.
 - 1. Barricade open excavations and post with warning lights.
 - 2. Comply with requirements of Section 01 5000 –TEMPORARY FACILITIES.
 - 3. Operate warning lights as recommended by authorities having jurisdiction.
 - 4. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations, from damages caused by settlement, lateral movement, undermining, washout and other hazards.
- D. Protection of Subgrade
 - 1. Protection of Subgrade: Do not allow equipment to pump or rut subgrade, stripped areas, footing excavations, or other areas prepared for project.
 - 2. At Contractor's option, and with the Geotechnical Engineer's approval, a working pad of granular material may be laid to protect footing and floor subgrade soils from disruption by traffic during wet conditions.
- E. Transport of soils.
 - 1. Transport all excess soils materials by legally approved methods to disposal areas.
 - 2. Coordinate with the District's Representative.
 - 3. Sufficient topsoil and fill material shall be retained from the site to complete project requirements.
 - 4. Any additional topsoil and fill requirements shall be the responsibility of the Contractor.

- F. Blasting and use of explosives will not be permitted.
- G. Dust Control Requirements: At all times during earthwork operations and until final completion and acceptance of the earthwork, the Contractor shall prevent the formation of an airborne dust and dirt nuisance from interfering with the surrounding normal operations. The Contractor shall effectively stabilize the site of work in such a manner that it will confine dust particles to the immediate surface of the work and to obtain a minimum of 40 percent emissions reduction by applying a dust palliative except in areas of active cut and fill. The dust palliative shall be non-petroleum based. Water alone is not considered to be a dust palliative. The dust palliative shall be applied at the rate and method in conformance with Section 18, "Dust Palliatives," of the Caltrans Standard Specifications and as recommended and/or specified by the manufacturer. Contractor shall assume liability for all claims related to dust and dirt nuisances.
- H. All areas to receive Structural Soil shall be inspected by the District's Representative prior to beginning this work.

1.7 EXISTING UTILITIES

- A. The District will contact local utility agencies prior to construction and arrange for the shut-off of all utilities serving the buildings to be demolished. Coordinate work required to abandon active lines with the Program Manager and the District.
- B. Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during excavation operations.
- C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the District's Representative immediately for directions.
 - 1. Cooperate with the District and public and private utility companies in keeping their respective services and facilities in operation.
 - 2. Repair damaged utilities to the satisfaction of the District's Representative.
- D. Do not interrupt existing utilities serving facilities occupied and used by the District or others, except when permitted in writing by the District and then only after acceptable temporary utility services have been provided.

1.8 SEQUENCING AND SCHEDULING:

- A. The schedule of operations shall be reviewed by the District's Representative prior to commencement of any work.
- B. Coordinate operations with other construction activities, such as relocation of existing utilities.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. General:
 - 1. Fill material will be subject to approval of the Geotechnical Engineer.
 - 2. The Geotechnical Engineer's report on acceptability shall be final and binding.
 - 3. During grading operations, soil types other than those analyzed in the geotechnical report for the project, may be encountered.

4. Consult the Geotechnical Engineer to determine the suitability of these soils.
 5. Organic content 3 percent by dry weight or less.
- B. Select Fill Material: Soil excavated from site (native) or imported conforming to requirements for fill material contained in geotechnical report for this project.
- C. Native Fill Requirements:
1. Approved native materials shall have a particle size not exceeding 3 inches as determined by ASTM D422, at least 90 percent relative compaction and contain less than 3 percent organic content by weight.
- D. Imported Fill Requirements: Imported fill, where required, shall be non expansive granular soil, free of organic matter and deleterious substances. Imported fill material shall be close-graded with 35 percent or more passing No. 4 sieve and either: Expansion Index of 50 or less, Plasticity Index of 12 or less, or less than 10 percent, by dry weight, passing No. 200 sieve.
1. Be thoroughly compactable without excessive voids.
 2. Meet the following plasticity requirements:
 - a. Maximum Plasticity Index of 12, as determined by ASTM D4318.
- E. Imported Fill for Planting Areas: Imported fill for use in planting areas shall be sandy loam weed free soil. Submit analysis from certified Soil and Plant Lab. Coordinate with Landscape Architect.
- F. Topsoil: Friable clay loam surface soil found in a depth of not less than 10 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2 inches in diameter, and without weeds, roots and other objectionable material.
1. Use topsoil for top 2 feet of fill against exterior walls, except at paving and sidewalks.
 2. Topsoil may also be used beyond the area within 5 feet of building, except under paving and sidewalks.
 3. Confirm suitability of stockpiled materials.
- G. Sand: Clean, well-graded fine to coarse sand with not more than 2 percent passing the #200 sieve based on wet sieve analysis. Provide at locations indicated in the construction documents.

Where coarse sand is required, provide sand no finer than No.40 sieve.

- H. Bioretention Soil Mixture
1. Follow Appendix L of the NPDES.
- J. Drain Rock:
1. Washed, uniformly graded mineral aggregate ASTM D448 with percentage composition of dry weight conforming to following limits:
 - a. Passing 1-inch Sieve: 100 percent.
 - b. Passing 3/4-inch Sieve: 90-100 percent.
 - c. Passing No. 4 Sieve: 0-10 percent.
 2. Base at Slab-on-Grade: As specified in the geotechnical report for this project.
 3. Absorption of water to saturated-surface dry condition shall not exceed 3 percent of oven-dry weight of a sample.
- K. Backfill material for use behind retaining walls shall be a granular material consisting of sand, broken rock, or a mixture of sand and gravel containing no size larger than 2 ½ inches and not more than 15 percent passing the No. 200 sieve.

- L. Trench Backfill:
 - 1. Trench Backfill above pipe zone material and in top 3 feet of building pad and top 1 foot below flatwork to be as per select fill and exclude rock/lumps retained on 4-inch sieve or 2-inch sieve in top 12 inches
 - 2. Trench backfill in all over locations to be or per general fill excluding rock/lumps retained on 4-inch sieve or 2-inch sieve in top 12 inches.
 - M. Pipe/Conduit Bedding Material: 90 to 100 percent (by mass) should pass No. 4 sieve, and 5 percent or less should pass No. 200 sieve.
 - N. Pea Gravel: 3/8 inch to 1/2 inch washed, uncrushed gravel. Use at drainage pipe and at other locations indicated.
 - O. Filter Fabric: Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D4759 and the referenced standard test method in parentheses.
 - 1. Grab Tensile Strength (ASTM D4632): 120 lb.
 - 2. Apparent Opening Size (ASTM D4751): #70 U.S. Standard sieve.
 - 3. Permeability (ASTM D4491): 135 gallons per minute per square foot.
 - P. Drainage Pipe:
 - 1. Perforated corrugated plastic drainage tubing meeting ASTM F667, with continuous integral nylon filter screen.
 - 2. Acceptable Manufacturers and Products: Advanced Drainage Systems "DrainGuard," Hancor "Agri-Flow."
 - 3. Provide couplings, elbows and other fittings as recommended by pipe manufacturer.
 - Q. Water: Clean and free from deleterious amounts of acids, alkalis, salts and organic matter.
- 2.2 SOIL STERILANT:
- A. Soil Sterilant shall be Treflan E.C. or approved equivalent.
- 2.3 TERMITICIDE:
- A. Termiticide shall be Permethrin, Denon, or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Prior to commencement of earthwork, become thoroughly familiar with site conditions.
- B. If event discrepancies are found, immediately notify the District's Representative in writing, indicating the nature and extent of differing conditions.
- C. Requirements:
 - 1. Grades and elevations are to be established with reference to benchmarks referenced on Drawings.
 - 2. Maintain engineering markers such as monuments, benchmarks and location stakes. If disturbed or destroyed, replace.

- D. No earthwork shall be performed without physical presence or acceptance of the Geotechnical Engineer.
- E. The Geotechnical Engineer's acceptance is required by these specifications; notify the District's Representative at least 48 hours prior to commencing any phase of earthwork.
 - 1. No phase of work shall proceed until prior phase has been accepted by the Geotechnical Engineer.
 - 2. Work shall not be covered up or continued until acceptance of the Geotechnical Engineer shall give written notice of conformance with the specifications upon completion of grading.
- F. Compacting:
 - 1. Compact by power tamping, rolling or combinations thereof as accepted by the Geotechnical Engineer.
 - 2. Where impractical to use rollers in close proximity to walls, stairs, etc., compact by mechanical tamping.
 - 3. Scarify and re-compact any layer not attaining compaction until required density is obtained.
 - 4. Compaction by flooding, ponding or jetting will not be permitted, unless specifically accepted by the Geotechnical Engineer.
- G. Hazardous Materials
 - 1. If any materials are encountered that may be hazardous (as defined in Section 25117 of the California Health and Safety Code), inform the District's Representative verbally within 24 hours and in writing within 2 business days. Upon discovery, material is to remain undisturbed until investigation by State's representative is complete. The removal and disposal of hazardous materials, if discovered, is not part of the scope of work of this Division for this project.

3.2 SITE PREPARATION:

- A. Protect structures, utilities, sidewalks, pavements, and other facilities which are to remain from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. Set up tree protection measures prior to commencing grading or demolition operations.
- B. Clearing and Grubbing:
 - 1. Remove from area of designated project earthwork all improvements and obstructions, including designated concrete curbs or slabs, asphaltic concrete, all tree and shrub roots, any abandoned buried utility, any irrigation lines, and other matter determined by the Geotechnical Engineer to be deleterious.
 - a. In all new planting areas, remove existing base material.
 - b. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing.
 - c. Vegetation should be removed to such a depth that organic material is generally not present.
 - 2. Remove from the site all trees and shrubs, unless otherwise indicated on the drawings as existing trees to be left standing.
 - 3. Active utilities with the project limit should be rerouted or protected from damage by construction activities.
 - 4. Rubble and excavated materials that do not meet the criteria of fill should be disposed of in an appropriate landfill.

5. Excavations resulting from the removal of buried utilities, tree stumps, or obstructions should be backfilled with compacted fill in accordance with the recommendations of the geotechnical report.
 6. Existing Trees to remain:
 - a. Verify the locations of existing trees to be preserved.
 - b. Replace existing trees to remain that are damaged during construction at no additional cost to the District.
 - c. Carefully make clean cuts at roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction. Paint cuts over ½ inch in size with tree pruning compound.
- C. Topsoil:
1. Strip topsoil to whatever depths encountered in manner to prevent intermingling with the underlying subsoil or other objectionable material.
 2. Remove heavy growths of grass from areas before stripping. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to the main root system.
 3. Stockpile topsoil in storage piles to freely drain surface water.
 4. Cover storage piles if required to prevent windblown dust.

3.3 EXISTING UTILITIES:

- A. Protect existing utilities that are to remain in operation as specified.
- B. Demolish and completely remove from the site existing underground utilities indicated to be removed. See Section 31 1000 – SITE PREPARATION AND DEMOLITION.
- C. Movement of construction machinery and equipment over existing pipes and utilities during construction shall be at contractor's risk.
- D. Excavation made with power-driven equipment is not permitted within 2 feet of any known utility or subsurface structure.
 1. Use hand or light equipment for excavating immediately adjacent to or for excavations exposing a utility or buried structure.
 2. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.
 3. Support uncovered lines or other existing work affected by excavation until approval for backfill is obtained.
 4. Report damage of utility line or subsurface structures immediately to the District's Representative.

3.4 PREPARATION OF SUBGRADE:

- A. Subgrade Preparation in areas constructed atop of expansive soils
 1. Under proposed buildings:
 - a. Over-excavate and replace the upper 3 feet of building pad subgrade with material conforming with Select fill requirements under section 2.1 of this specification.
 - b. Alternatively, the Contractor has an option to chemical treat the onsite soil with a combination of quicklime and cement stabilization
 - c. Chemically treated soil must conform to ASTM C977 Standards and achieve ASTM D1557 compaction standards
 - d. Contractor must submit a copy of their chemical proposed process to the geotechnical engineer for approval of the chemical treatment application.

2. Under Pavement and Flatwork:
 - a. Over-excavate and replace the upper 1 foot of pavement subgrade with imported select fill conforming with requirements detailed under section 2.1.B of this specification.
 - b. Alternatively, the Contractor has an option to replace material with chemically treated onsite soil.
 - c. Chemically treated soil must conform to ASTM C977 Standards and achieve ASTM D1557 compaction standards
 - d. Contractor must submit a copy of their chemical proposed process to the geotechnical engineer for approval of the chemical treatment application.
- B. Subgrade Preparation in areas constructed atop of non-expansive soils and landscape areas
 1. Exposed subgrade should have the top 8 inches scarified, moisture conditioned and compacted to 90 percent of the reference density as evaluated by ASTM D1557

3.5 DEWATERING:

- A. Do not allow water from surface drainage or underground sources to accumulate in excavations, unfinished fills, or other low areas.
- B. Provide and maintain ample means and devices to remove water promptly and dispose properly of water entering excavations or other parts of the work to prevent softening of exposed surfaces.
- C. Dewater by methods which will ensure dry excavation and preservation of finish lines and grades of excavation bottoms.
- D. Prior to excavating below ground water level, place dewatering system in operation.
 1. Lower the ground water level a minimum of 1 foot below the bottom of the excavation.
 2. Relieve the hydrostatic pressure in pervious zones below the subgrade elevation to prevent uplift.
 3. Use screens and gravel packs as necessary to prevent removal of fines from the soil.
- E. Operate the dewatering system continuously, 24 hours a day, 7 days a week until construction work below existing ground water level is completed.
 1. Measure and record the performance of the dewatering system.
 2. After placement of initial slabs and backfill, the ground water level may be allowed to rise.
 3. At no time allow ground water to rise higher than 1 foot below the prevailing level of excavation or backfill.
 4. Have a back-up pump and system available for immediate use.
- F. Dispose of water away from the work in suitable manner without damage to adjacent property or menace to public health.
- G. Do not drain water into work being built or under construction without prior acceptance of the District's Representative.
- H. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the District.

3.6 SITE EXCAVATION:

A. General

1. All supports, shoring, and sheet piling required for the sides of excavations or for protection of adjacent existing improvements shall be provided and maintained by the Contractor. The adequacy of such systems shall be the complete responsibility of the Contractor.
2. Earth and rock, regardless of character and subsurface conditions, shall be excavated to depths shown on drawings and to the neat dimensions of the footings wherever practicable, to permit pouring of footings and grade beams without use of side forms, except at slab perimeters.
3. Large rocks, pieces of concrete or other obstructions, if encountered during the excavation/scarifying operations, shall be removed and disposed of by the Contractor off the site in a legal manner.
4. Where footing excavation is too deep, backfill shall be concrete. Where footings are over dug laterally, side forms shall be employed for backfill with rock fill or concrete backfill shall be used (Contractor's option).
5. Where forming is required, only that excavation necessary to permit placing and removal of forms shall be done.
6. Bottoms of all footings and foundations trenches shall be subject to testing by the Geotechnical Engineer. Corrective measures as directed by the State's representative shall be executed promptly.

B. Excavate subgrade as required to allow for finish grades shown on drawings, as required for structural fill or otherwise required for proper completion of the work.

C. Remove and replace subgrade materials designated by Geotechnical Engineer as unsuitable.

3.7 FILL AND COMPACTING:

A. General Requirements:

1. Backfill excavations as promptly as work permits.
2. Do not place engineered fill or backfill until rubbish and deleterious materials have been removed and areas have been approved by the District's Representative.
3. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.
4. In excavations, use satisfactory excavated or borrow material.
5. Under grassed areas, use satisfactory excavated or borrow material.

B. After subgrade compaction has been approved by the Geotechnical Engineer, spread the engineered fill materials in lifts not exceeding 8 inches and uniformly mixed during the spreading operation.

1. Bring non-expansive fill materials to or slightly above the optimum moisture content and compacted to at least 90 percent of the maximum laboratory dry density, per ASTM D1557.
2. Bring non-expansive aggregate fill materials to or slightly above the optimum moisture content and compacted to at least 95 percent of the maximum laboratory dry density, per ASTM D1557.
3. Do not compact the top 12 inches of soil in the planting areas.
4. Fill sections greater than 5 feet in depth shall be compacted to at least 95 percent.

C. Repeat compaction procedure until proper grade is attained.

- D. Rocks generated during site earthwork may be used in fill when conforming to material specifications.

3.8 MOISTURE CONTROL:

- A. Do not place, spread or roll fill material during unfavorable weather conditions or when fill material is excessively wet.
- B. Do not resume operations until moisture content and fill density are satisfactory to the Geotechnical Engineer.
- C. Provide berms or channels to prevent surface water from flooding excavations. Promptly remove water collecting in depressions.
- D. Where soil has been softened or eroded by flooding or by placement during unfavorable weather, remove damaged areas and re-compact as described for fill and compaction.
- E. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material.
 - 1. Prevent free water appearing on surface during or subsequent to compaction operation.
 - 2. Remove and replace, or scarify and air dry, soil material too wet to permit compaction to specified density.
 - 3. Soil material removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.9 GRADING:

- A. General: Uniformly grade areas of work including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
 - 1. All areas covered by the project, including excavated and filled areas and adjacent transition areas, shall be uniformly graded so that finished surfaces are at the elevations established by the plans. Planter areas to receive future topsoil shall be graded below finished grade to allow for such material.
 - 2. Finished surfaces and surfaces to receive paving and aggregate base shall be smooth, compacted, and free from irregular surface drainage.
 - 3. Ditches, gutters, and swales shall be finished to permit proper surface drainage.
 - 4. All surface areas, except paved and sloped embankments exceeding 8:1, shall be hydroseeded in accordance with specifications in Landscaping Sections.
- B. Grading Tolerances:
 - 1. Excavations shall not exceed 0.10-foot variation from dimensions and elevations shown or noted, unless otherwise approved by the District's Representative.
 - 2. Fill and backfill shall be placed with tolerance of plus or minus 0.10 foot if placed in layers.
 - 3. Grading shall be done within plus or minus 0.10 foot typically; areas under slabs, walks or pavements shall be graded within tolerance of 0 to 0.10 foot.
 - 4. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
 - 5. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.

6. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than ½ inch above or below required subgrade elevation.

C. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.10 SOIL STERILIZATION:

A. General: Soil sterilant shall be applied to prepared subgrade or after installation of rock or aggregate base as recommended by the manufacturer. Sterilant shall be applied uniformly at the rate recommended by the manufacturer to all areas beneath asphalt concrete pavement, brick pavement, concrete pavement, or on-grade concrete slabs including sidewalks, curbs, and gutters and areas between the inner and outer security fences. In addition to ground areas treated, sterilant shall be applied below expansion or control joints, and at all areas where pipe, ducts, or other features penetrate slabs.

3.11 BIORETENTION SOIL MIXTURE

A. General: Soil material installed in bio-retention and bio-swales shall be tested in-site to verify the field conditions meet performance requirements.

B. Installation: Place soil material in lifts not exceeding 8-inches. Compact to between 83 and 87 percent relative compaction.

C. Testing: Demonstrate in-site percolation by the following method. One test shall be performed for each treatment measure.

1. Drive a 1 foot diameter pipe 2.5 feet long into the treatment soil until the end is 6 inches above the under drainage (typically 12-inches down).
2. Wet treatment zone then fill pipe with water to 12 inches above ground elevation.
3. Pipe should empty 12 inches of water within the following time periods:

<u>Soil Type</u>	<u>Min</u>	<u>Max</u>
Dewatering	1hr 12min	6hrs
Treatment	1hr 12min	2hrs 24min

4. If the in-situ test fails the soil within the treatment measures shall be removed and re-instated.

3.12 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Removal of Excess Excavated Material: Excess material shall be removed by the Contractor off the site in a legal manner.

3.13 FIELD QUALITY CONTROL:

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D1556 (sand cone method), ASTM D2167 (Rubber Balloon Method), or ASTM D2937 (Drive Cylinder Method), as applicable.
 - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D6938 , provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556. With each density calibration check, check the calibration curves furnished with the moisture gauges according to ASTM D6938

- b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work on each different type of material encountered, and at intervals as directed by the Architect.
 2. Footing Subgrade: At footing subgrades, use a hand probe and consult with the Geotechnical Engineer.
 3. Paved and Building Slab Areas; At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 square feet or less of paved area or building slab, but in no case fewer than three tests.
 4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
 5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but not fewer than two tests.
- B. Number and location of test shall be at option of the Geotechnical Engineer.
- C. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.
- D. After grading is completed and the testing agency has completed observation of the work, permit no further excavation or filling, except as approved by the District's Representative.
- 3.14 PROTECTION:
- A. Protect newly graded areas from traffic and erosion. In unpaved areas without landscaping, cover with straw erosion control blanket. Follow manufacturer's recommendations for installation. Provide and place straw wattles or biodegradable fiber logs across the slope at the midpoint and along the downhill edge of site. No soil is to be left uncovered at the completion of construction. Keep free of trash and debris.
 - B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
 - C. Where completed compacted areas are disturbed by subsequent construction operation or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work, including retesting, prior to further construction.
- 3.15 CLEAN-UP:
- A. Comply with requirements of Section 017400 – CLEANING.
- 3.16 TERMITICIDE:
- A. Termiticide shall be applied to soils as recommended by the manufacturer. Termiticide shall be applied uniformly at the rate recommended by the manufacturer to all areas beneath and around wood frame structures.

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SECTION 31 2333

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 – GENERAL

1.1 SUMMARY:

- A. Provide labor, material, equipment, and services necessary to complete the backfilling and compacting as necessary for this project. Section includes, but is not limited to:
 - 1. Initial Backfill Material.
 - 2. Subsequent Backfill.
 - 3. Detectable Tape.
 - 4. Trench Excavation.
 - 5. Pipe Bedding.
 - 6. Trench Backfill.
 - 7. Trench Surfacing.
- B. Work specified in Related Sections include:
 - 1. Section 31 2200 – EARTHWORK AND GRADING.
 - 2. Section 33 1000 – WATER SYSTEMS.
 - 3. Section 33 3000 – SANITARY SEWER.
 - 4. Section 33 4000 – STORM DRAINAGE.

1.2 DEFINITIONS:

- A. Engineered Fill:
 - 1. Soil or soil-rock material approved by the Geotechnical Engineer and transported to the site by the Contractor in order to raise grades or to backfill excavations.
 - 2. Contractor shall provide sufficient tests, and a written statement that all materials brought onto the project site comply with specification requirements.
- B. Excavation: Consists of the removal of material encountered to subgrade elevations.
- C. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base.
- D. Base: The layer placed between the subgrade and surface pavement in a paving system.
- E. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure American Society for Testing and Materials (ASTM) D1557.

1.3 SYSTEM DESCRIPTION:

- A. Requirements:
 - 1. Comply with the recommendations of the Geotechnical Engineer.
 - 2. Protect existing trees to remain. No grading is permitted under the drip line of protected trees.
 - 3. Excavations for appurtenant structures, such as, but not limited to, manholes, transition structures, junction structure, vaults, valve boxes, catch basins, thrust blocks, and boring pits, shall be deemed to be in the category of trench excavation.
 - 4. Unless otherwise indicated in the Drawings, all excavation for pipelines shall be open cut.

1.4 SUBMITTALS:

- A. Comply with provisions of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Test Reports: Submit the following report for import material directly to the District's Representative from the Contractor's testing services:
 - 1. Compaction test reports for import materials.
- C. Submit description of compactors proposed for use when requesting placement of base material.

1.5 QUALITY ASSURANCE:

- A. Requirements of Regulatory Agencies:
 - 1. Comply with State of California Business and Transportation Agency, Department of Transportation (Caltrans) latest edition of "Standard Specifications." (Caltrans Standard Specification).
 - 2. Comply with State of California Code of Regulations (CCR).
 - 3. Comply with State of California Construction Safety Orders, Latest Edition (CAL/OSHA).
- B. Soil Testing:
 - 1. District shall engage a geotechnical testing agency, to include compaction testing and for quality control testing during fill operations.
 - 2. Test results will be submitted to the District's Representative.
- C. Codes and Standards:
 - 1. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
 - 2. NPDES Construction General Permit.
 - 3. Project Storm Water Pollution Prevention Plan (SWPPP)
 - 4. California Department of Transportation Standard Specifications (Caltrans Standard Specification):
 - a. Section 19: Earthwork.
 - b. Standard Test Methods: No. 202.
 - 5. American Society for Testing and Materials (ASTM):
 - a. D1556: Density of Soil by the Sand Cone Method.
 - b. D1557: Moisture Density Relations of Soils and Soil-Aggregate Mixtures.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Protect materials before, during and after installation.
- B. Comply with provisions of Section 01 5700 – TEMPORARY FACILITIES AND CONTROLS where necessary to control dust and noise on and near the work caused by operations during construction activities.

1.7 PROJECT CONDITIONS:

- A. Environmental Requirements:
 - 1. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the District.
 - 2. Protect existing streams, ditches and storm drain inlets during work on this project.
- B. Barricade open excavations and post with warning lights.

1. Comply with requirements of Section 01 5700 – TEMPORARY FACILITIES AND CONTROLS.
 2. Operate warning lights and barricades as required.
 3. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations, from damages caused by settlement, lateral movement, undermining, washout, and other hazards.
- C. Protection of Subgrade: Do not allow equipment to pump or rut subgrade, stripped areas, footing excavations, or other areas prepared for project.
- D. Transport all excess soils materials by legally approved methods to disposal areas.
1. Coordinate with the District's Representative.
 2. Any additional fill requirements shall be the responsibility of the Contractor.
- 1.8 EXISTING UTILITIES:
- A. Locate existing underground utilities in the areas of work. For utilities that are to remain in place, provide adequate means of protection during excavation operations.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility agency immediately for directions.
1. Cooperate with the District's Representative and public and private utility companies in keeping their respective services and facilities in operation.
 2. Repair damaged utilities to the satisfaction of the utility owner.
- C. Do not interrupt existing utilities serving facilities occupied and used by the District or others, except when permitted in writing by the District's Representative and then only after acceptable temporary utility services have been provided.
- 1.9 SEQUENCING AND SCHEDULING:
- A. The sequence of operations shall be reviewed by the District's Representative prior to commencement of any work.

PART 2 – PRODUCTS

2.1 MATERIALS:

- A. General:
1. Backfill materials will be subject to approval of the Engineer.
 2. For approval of backfill fill material, notify the District's Representative at least 7 days in advance of intention to import material.
 3. Consideration shall also be given to the environmental characteristics as well as the corrosion potential of backfill materials. Laboratory testing, including pH, soluble sulfates, chlorides, and resistivity shall be reviewed. Backfill materials shall not be more corrosive than the native materials.
- B. Trench Sand:
1. Material free from clay, organic materials, and other deleterious substances and conforming to Caltrans Standard Specification Section 19-3.02F(2).
- C. Trench Gravel:
1. Granular material free from clay, organic materials, and other deleterious substances and conforming to Class 1 Type A Permeable Material, per Caltrans Standard Specification Section 68-2.02F(2).

- D. Approved Native Fill:
 - 1. See Section 31 2200 – EARTHWORK AND GRADING.
- E. Imported Fill:
 - 1. See Section 31 2200 – EARTHWORK AND GRADING.
- F. Class II Aggregate Base: $\frac{3}{4}$ " maximum, Class II AB, free from organic matter and other deleterious substances and conforming to Caltrans Standard Specification Section 26-1.02A.
- G. Controlled Low Strength Material (CLSM):
 - 1. Low strength structural backfill with a compressive strength between 50 and 100 psi, conforming to Caltrans Standard Specifications Section 19-3.02G.
- H. Water: Clean and free from deleterious amounts of acids, alkalis, salts and organic matter.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

- A. Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.
 - 1. Warning Tape Color Codes.
 - Red: Electric.
 - Yellow: Gas, Oil; Dangerous Materials.
 - Orange: Telephone and Other Communications.
 - Blue: Water Systems.
 - Green: Sewer Systems.
 - White: Steam Systems.
 - Gray: Compressed Air.
 - 2. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.
 - 3. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

- A. Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Prior to commencement of work, become thoroughly familiar with site conditions.

- B. In the event discrepancies are found, immediately notify the District's Representative in writing, indicating the nature and extent of differing conditions.
- C. Backfill excavations as promptly as work permits.
- D. Do not place engineered fill or backfill until rubbish and deleterious materials have been removed and areas have been approved by the District's Representative.
- E. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.
- F. In excavations, use satisfactory excavated or borrow material.
- G. Under grassed areas, use satisfactory excavated or borrow material.

3.2 COMPACTING:

- A. Compact by power tamping, rolling or combinations thereof.
 - 1. Where impractical to use rollers in close proximity to walls, stairs, etc., compact by mechanical tamping.
 - 2. Scarify and re-compact any layer not attaining compaction until required density is obtained.

3.3 SITE PREPARATION:

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, which are to remain, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the District.

3.4 EXISTING UTILITIES:

- A. Identify the location of existing utilities.
 - 1. Prior to trenching, the Contractor shall excavate at locations specifically indicated on the Drawings, if any, and where new lines cross other utilities of uncertain depth and determine the elevation of the utility in question to ensure that the new line will clear the potential obstruction.
 - 2. The Contractor shall contact Underground Service Alert (USA) at 811 for assistance in locating existing utilities.
 - 3. If, after the excavation, a crossing utility does present an obstruction, then the line and grade of the new line will be adjusted as directed by the Engineer of Record to clear the utility.
- B. Protect all existing utilities to remain in operation.
- C. Movement of construction machinery and equipment over existing pipes and utilities during construction shall be at Contractor's risk.
- D. Excavation made with power-driven equipment is not permitted within 2 feet of any known utility or subsurface structure.
 - 1. Use hand or light equipment for excavating immediately adjacent to known utilities or for excavations exposing a utility or buried structure.

2. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.
3. Support uncovered lines or other existing work affected by excavation until approval for backfill is obtained.
4. Report damage of utility line or subsurface structures immediately to the District's Representative.

E. Backfill trenches resulting from utility removal in accordance with this section.

3.5 TRENCH EXCAVATION

A. General:

1. Excavation shall include removal of all water and materials that interfere with construction. The Contractor shall remove any water which may be encountered in the trench by pumping or other methods during the pipe laying, bedding and backfill operations. Material shall be sufficiently dry to permit approved jointing.
2. Excavation shall include the construction and maintenance of bridges required for vehicular and pedestrian traffic, support for adjoining utilities.
3. The Contractor shall be responsible to safely direct vehicular and pedestrian traffic through or around his/her work area at all times.
4. The Contractor shall relocate, reconstruct, replace or repair, at his/her own expense, all improvements which are in the line of construction or which may be damaged, removed, disrupted or otherwise disturbed by the Contractor.

B. Existing Paving and Concrete:

1. Existing pavement over trench shall be saw cut, removed, and hauled away from the job. Existing pavement shall be neatly saw cut a minimum of 6-inches beyond the limits of excavations.
2. Existing concrete over the trench shall be saw cut to a full depth in straight lines either parallel to the curb or right angles to the alignment of the sidewalk.
3. Boards or other suitable material shall be placed under equipment out rigging to prevent damage to paved surfaces.

C. Trench Width:

1. The maximum allowable trench widths at the top of the pipe shall be as follows:

<u>Pipe Type</u>	<u>Trench Width (Maximum)</u>
Copper	Outside diameter of barrel plus 18 inches
Plastic	"
Vitrified Clay	"
Cast-Iron	Outside diameter of barrel plus 24 inches
Ductile-Iron	"
Reinforced Concrete	

- a. The maximum trench width shall be inclusive of all shoring.
- b. If the maximum trench width is exceeded, the District's Representative or Inspector of Record may direct the Contractor to encase or cradle the pipe in concrete at no additional charge.
2. For pipes 3 inch diameter and larger, the free working space on each side of the pipe barrel shall not be less than 6 inches.

D. Open Trench:

1. The maximum length of open trench shall be 300 feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is greater. No trench shall be left open at the end of the day.
 2. Provisions for trench crossings and free access shall be made at all street crossings, driveways, water gate valves, and fire hydrants.
- E. Excavation Bracing:
1. The excavation shall be supported and excavation operations shall be conducted in accordance with the California Industrial Accident Commission and CAL/OSHA.
 2. The Contractor shall, at his/her own expense, furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of all excavations (whether above or below the pipe grade), and to prevent any movement which could in any way diminish the required trench section or otherwise injure or delay the work. The sheeting and bracing shall be withdrawn in a manner such as to prevent any earth movement that might overload the pipe.
- F. Excavated Material:
1. All excavated material not required for backfill shall be immediately removed and properly disposed of in a legal manner by the Contractor.
 2. Material excavated in streets and roadways shall be laid alongside the trench no closer than 2 feet from the trench edge and kept trimmed to minimize inconvenience to public traffic.
 3. Provisions shall be made whereby all storm and wastewater can flow uninterrupted in gutters or drainage channels.

3.6 PIPE BEDDING

- A. Bedding Excavation: The trench shall be excavated below the grade of the pipe bottom to the following minimum depths:
- | <u>Pipe Type</u> | <u>Depth</u> |
|--------------------------------------|--------------|
| Copper | 3 inch |
| Reinforced Concrete | 3 inch |
| Plastic: 2 inch diameter and smaller | 3 inch |
| Cast/Ductile Iron | 6 inch |
| Plastic: over 2 inch diameter | 6 inch |
1. Stabilization of Trench Bottom: When the trench bottom is unstable due to wet or spongy foundation, trench bottom shall be stabilized with gravel or crushed rock. The Inspector of Record will determine the suitability of the trench bottom and the amount of gravel or crushed rock needed to stabilize a soft foundation. Soft material shall be removed and replaced with gravel or crushed rock as necessary.
 2. Placement of Bedding Material: The trench bottom shall be cleaned to remove all loose native material prior to placing pipe bedding material. Pipe bedding shall be trench sand or trench gravel, as defined in these specifications. Sufficient pipe bedding material shall be placed in trench and tamped to bring trench bottom up to grade of the bottom of pipe, plus 1/8th of the pipe diameter. The relative compaction of tamped material shall be not less than 90 percent. It is the intention of these requirements to provide uniform bearing under the full length of pipe to a minimum width of 60 percent of the external diameter.

3.7 TRENCH BACKFILL

- A. Initial Backfill:
1. Prior to trench backfill, the condition of the trench and lying of pipe must be inspected and approved by the Inspector of Record.

2. Trench Sand and Trench Gravel shall be used for initial backfill. After the pipe has been properly laid and inspected, initial backfill material shall be placed on both sides of the pipe and compacted to final depth as follows:

<u>Pipe Type</u>	<u>Depth</u>
Copper	6 inches above top of pipe
Cast Iron	6 inches above top of pipe
Plastic: less than 3 inches diameter	6 inches above top of pipe
Plastic: 3 inches diameter and larger	12 inches above top of pipe
Ductile Iron	12 inches above top of pipe
Reinforced Concrete	½ outside diameter of pipe (pipe spring line)

3. Compaction: Initial backfill compaction shall be by mechanical means. The initial backfill material shall be hand tamped in layers not exceeding 4 inches in un-compacted depth and shall be brought up uniformly on both sides of the pipe to avoid bending or distortional stress. After hand tamping, the relative compaction of the initial backfill material shall be not less than 90 percent.
4. Pipe Detection: In trenches containing pressurized plastic pipes, tracer wire shall be placed directly above the pipe and shall be connected to all valves, existing exposed tracer wires, and other appurtenances as appropriate.

B. Subsequent Backfill:

1. Subsequent backfill material shall consist of approved native material, imported fill, or Class II AB conforming to these specifications.
2. Structure and utility trench backfill should be moisture conditioned, placed in lifts eight inches or less in loose thickness, and mechanically compacted to at least 90 percent relative compaction except the relative compaction shall not be less than 95 percent within 2-1/2 feet of finished permanent surface grade or 1-1/2 feet below the finished subgrade, whichever is greater; jetting will not be permitted. The moderately expansive clay soils exposed in trenches should not be allowed to dry out prior to placement of trench backfill materials.
3. It must be the contractor's responsibility to select equipment and procedures that will accomplish the grading as described above. He/she must organize his/her work in such a manner that the Soil Engineer can test and/or observe each element of grading.

C. Controlled Low Strength Material (CLSM):

1. CLSM is permitted at Engineer of Records discretion or where indicated on the contract documents.

D. Jetting and Ponding:

1. Jetting of trench backfill is not permitted.

E. Compaction Testing:

1. Compaction testing shall be in accordance with California Test Method ASTM D1556 or D1557.

3.8 TRENCH SURFACING

A. Unpaved Areas:

1. In unimproved areas, the trench surface shall be restored to its original condition. No mounds of earth shall be left along the trench. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
2. Where completed compacted areas are disturbed by subsequent construction operation or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work, including retesting, prior to further construction.

B. Temporary Surfacing:

1. Temporary surfacing shall be a minimum of 2 inches of cutback asphalt on 10 inches of Class 2 aggregate base and shall be placed at all trench locations subject to vehicular or pedestrian traffic.
2. Temporary surfacing shall be laid within one day after backfilling (except where the Contractor elects to place permanent surfacing within this time period).
3. Before the trenching area is opened for traffic, all excess dirt, rock, and debris shall be removed, the street surface shall be swept clean and the pavement shall be washed down with a water truck and pressure nozzle.
4. Temporary surfacing shall be maintained to prevent the occurrence of mud holes and prevent the surface from settling below 1 inch or rising more than 1 inch from the existing pavement grade.

3.9 MOISTURE CONTROL:

- A. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS:

- A. Testing Services: Allow testing agency to test each backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
- B. When testing agency reports that backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.

3.11 PROTECTION:

- A. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operation or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work, including retesting, prior to further construction.

3.12 CLEAN-UP:

- A. Remove all debris, equipment, tools and materials upon completion prior to final inspections to the satisfaction of the engineer.
- B. In unpaved areas without landscaping, cover with straw erosion control blanket. Follow manufacturer's recommendations for installation. Provide and place straw wattles or biodegradable fiber logs across the slope at the midpoint and along the downhill edge of site. No soil is to be left uncovered at the completions of construction.

END OF SECTION

SECTION 32 1233

PAVING AND SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes (but is not necessarily limited to):
 - 1. Asphalt Concrete Paving.
 - 2. Portland Cement Concrete Paving.
 - 3. Liquid Asphalt and Asphalt Emulsion.
 - 4. Aggregate Base.
 - 5. Concrete Pavers.
 - 6. Decomposed Granite.
 - 7. Sealants
- B. Related work furnished under other sections but conforming to the provisions of this section:
 - 1. Subgrade preparation.
 - 2. Aggregate Base installation.
- C. Related Sections:
 - 1. Section 31 1000 – SITE PREPARATION AND DEMOLITION.
 - 2. Section 31 2200 – EARTHWORK AND GRADING.
 - 3. Section 32 1723 – PAVEMENT MARKING.
 - 4. Section 32 1315 – PERVIOUS CONCRETE

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A615: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. C150: Portland Cement.
 - 3. D1557: Moisture Unit Weight Relations of Soils and Aggregate Mixtures Using a 10 lb (4.5 kg) Rammer and 18 in. (457 mm) Drop.
 - 4. D1682: Breaking Loads and Elongation of Textile Fabrics.
- B. California Code of Regulations (CCR): Title 24, Chapter 2-71, Site Development Requirements for ADA Accessibility.
- C. California Department of Transportation (Caltrans):
 - 1. Standard Specifications:
 - a. Section 20-10: Decomposed Granite.
 - b. Section 24: Stabilized Soils.
 - c. Section 26: Aggregate Bases.
 - d. Section 37: Bituminous Seals.
 - e. Section 39: Asphalt Concrete.
 - f. Section 40: Concrete Pavement.
 - g. Section 41: Concrete Pavement Repair.
 - h. Section 51: Concrete Structures.
 - i. Section 52: Reinforcement.
 - j. Section 73: Concrete Curbs and Sidewalks.
 - k. Section 88: Geosynthetics.
 - l. Section 90: Portland Cement Concrete.
 - m. Section 92: Asphalts.
 - n. Section 93: Liquid Asphalts.
 - o. Section 94: Asphaltic Emulsions.

- p. Section 95: Epoxy
- 2. Traffic Manual.
- 3. Highway Design.

- D. Institute of Transportation Engineers: Transportation and Traffic Engineering Handbook.
- E. American Concrete Institute Manual of Practice.
- F. Interlocking Concrete Pavement Institute (ICPI).

1.3 SUBMITTALS

- A. Requirements: Refer to Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Asphalt Concrete Paving:
 - 1. Provide copies of material certificates signed by the material producer and the Contractor, certifying that each material item complies with or exceeds specified requirements.
 - 2. The Contractor shall furnish a certified weight or load slip for each load of material used in the construction of the asphalt concrete pavement.
- C. Concrete Paving: The Contractor shall furnish mill test reports on the cement, reinforcement bars, and aggregates, showing compliance with the respective specifications. The Testing Engineer may make concrete test cylinders and slump tests as deemed necessary to determine compliance with the Specifications.
- D. Liquid Asphalt.
- E. Pavement Reinforcement Fabric.
- F. Tack Coat.
- G. Pavement Reinforcement Mesh.
- H. Structural Geotextile Fabric.
- I. Concrete Pavers.
- J. Slurry Seal.
- K. Joint Sealants.
- L. Backer Rod.
- M. Joint Filler.
- N. Epoxy Crack Filler.
- O. Bonding Epoxy.
- P. Concrete Quality Control Plan. Inclusive of the following:
 - 1. Placing and timing of joints including a location plan for all joints
 - 2. Bar placement, alignment
 - 3. Concrete placement methods
 - 4. Finishing and curing methods and timing.
 - 5. Joint sealants and timing of placement

1.4 PROJECT CONDITIONS

- A. Liquid Asphalt and Asphalt Emulsion:
 1. Seal coat and paint binder shall be applied only when the ambient temperature is above 50° Fahrenheit and when temperature has not been below 35° Fahrenheit for 12 hours immediately prior to application.
 2. Fog coat, seal coat, and paint binder shall not be applied when base or surfaces are wet or contain excess moisture.
- B. Asphalt Concrete Paving: Asphalt concrete surfaces shall be constructed only when ambient temperature is above 50° Fahrenheit and when base is dry.
- C. Portland Cement Concrete: Concrete shall be placed when the conditions will yield satisfactory results and when the ambient temperature will be above 40°F for 72 hours after placement with no threat of precipitation.
- D. Joint Sealants: Sealants shall be placed per the manufacturers recommendations and when temperature is above 40°F for 2 days after and no threat of precipitation.

PART 2 - PRODUCTS

2.1 PAVING MATERIALS

- A. Aggregate Base: Aggregate base shall conform to Caltrans Class 2 (R value 78 min) aggregate base, 3/4" maximum size, as specified in Section 26 of the Caltrans Standard Specifications.
- B. Asphalt Concrete Paving:
 1. Shall be Type A HMA, conforming to Section 39-2.02B of the Caltrans Standard Specifications.
 2. Asphalt binder to be mixed with aggregate shall be performance-graded asphalt, PG64-10, conforming to Section 92 of the Caltrans Standard Specifications.
 3. Aggregate size shall be as follows:

Total AC Thickness	Min # of AC lifts	Aggregate Grading
3/4 inch – 1-1/2 inch	1	1/2" max
2 inch – 2-1/2 inch	1	1/2" max
3 inch or greater	2	1/2" max for top lift and 3/4" max for initial lifts
 4. If multiple lifts, apply a tack coat before placing a subsequent lift.
 5. Asphaltic emulsion for paint binder, fog coat, and seal coat shall be emulsified asphalt, Type SS-1h, conforming to Section 94 of the Caltrans Standard Specifications.
- C. Portland Cement Concrete:
 1. Concrete shall be minor concrete conforming to Section 90-2 of the Caltrans Standard Specifications, except as modified by these specifications.
 2. Concrete Pavement shall contain a minimum of 505 lbs/yard of cementitious material.
 3. Cement shall be a combination of Type II or Type V Portland cement and supplemental cementitious materials conforming to Section 90-1.02B of the Caltrans Standard Specifications.
 4. For minor concrete, the maximum aggregate size must not be larger than 1-1/2 inches or smaller than 3/4 inch, per Section 90-2.02C of the Caltrans Standard Specifications.
 5. Water shall be potable and free of organic matter and injurious amounts of oil, acid, alkali, or other deleterious substances.

- 6. Unless otherwise noted on the plans the concrete mix design shall provide a minimum compressive strength of 3,000 psi at 28 days.
 - 7. Supplementary Cementitious Materials (SCM) shall comply with Section 90-1.02B(3) of the Caltrans Standard Specifications including chemical properties, physical properties, and proportioning.
 - 8. Reinforcing bars shall be deformed and shall conform to ASTM A615.
 - 9. Filled joints, unless noted otherwise on the Drawings, shall be 1/4-inch wide, the full depth of the concrete section and conforming to Section 51 of the Caltrans Standard Specifications.
 - 10. Joint filler shall conform to Section 51 of the Caltrans Standard Specifications for pre-molded expansion joint filler and expanded polystyrene joint filler.
 - 11. No admixtures will be allowed without prior approval of the Engineer of Record.
- D. Epoxy shall meet the requirements of Section 95 of the Caltrans standard specifications.
- 1. Epoxy used to bond dowels to hardened concrete shall be Type 1, Grade 1, Class B or C per ASTM C881.
 - 2. For high strength applications epoxy shall be Type IV.
- E. Decomposed Granite:
- 1. Decomposed Granite shall conform to Section 20-5.03D of the Caltrans Standard Specifications.
 - 2. Soil Sterilant shall be oxadiazone granular preemergent complying with Caltrans Standard Specification Section 20-5.03A(2).
 - 3. Edging shall comply with Caltrans Standard Specification Section 20-5.02.
 - 4. Crushed granite rock gradation shall comply with Caltrans Specification Section 20-5.03D(2).
 - 5. Solidifying Emulsion shall be either a water-based polymer or non-toxic organic powdered binder specifically manufactured to harden decomposed granite. The solidifying emulsion shall not alter the decomposed granite color.
- F. Concrete Pavers: Concrete Pavers shall be in accordance with the drawings, patterns, and details as shown on the plans and/or contained within these specifications. All paving stones shall be produced by a single source manufacturer in accordance with ICPI standards and guidelines and shall conform to the following:
- 1. Minimum compressive strength of 8,000 psi in accordance with testing procedures ASTM C936.
 - 2. Paver length and width shall not vary by more than (+/-) 1/16" in unit dimension. Paver height shall not vary by more than (+/-) 1/8" from specified standard dimensions.
- G. Crushed Stone Filler, Bedding, Base and Subbase for Permeable Pavers
- 1. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C131, minimum CBR of 80% per ASTM D1883.
 - 2. Do not use rounded river gravel.
 - 3. All stone materials shall be washed with less than 1% passing the No. 200 sieve.
 - 4. Joint filler, bedding, base and subbase: conforming to ASTM D448 gradation as follows:

ASTM No. 8 Grading Requirements	
Bedding and Joint Filler	
Sieve Size	Percent Passing
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16)	0 to 5

ASTM No. 57 Base Grading Requirements	
Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

Grading Requirement for ASTM No. 2 Subbase	
Sieve Size	Percent Passing
75 mm (3 in.)	100
63 mm (2 1/2 in.)	90 to 100
50 mm (2 in.)	35 to 70
37.5 mm (1 1/2 in.)	0 to 15
19 mm (3/4 in.)	0 to 5

5. Gradation criteria for bedding and base materials:

Note: Dx is the particle size at which x percent of the particles are finer. For example, D15 is the particle size of the aggregate for which 15% of the are smaller and 85% are larger.

 - a. D15 base stone /D50 bedding stone < 5.
 - b. D50 base stone/D50 bedding stone > 2.

- H. Pavement Reinforcement Fabric: Pavement reinforcement fabric shall meet Caltrans Section 96-1.02J. BP Petromat, or approved equivalent.

- I. Crack Sealant:
 1. Crack sealant shall be rubberized hot-pour type and shall meet ASTM D 3405. Husky 1611, or approved equivalent.
 2. Blotting Agent shall be one of: Screened sand, cement, or fly ash.

- J. Tack coat: Tack coat shall meet Caltrans Section 39-2.01B(10).

- K. Pavement reinforcement mesh: Pavement reinforcement mesh for use in overlays shall be Glasgrid Model 8501, or approved equivalent.

- L. Structural geotextile fabric: Structural geotextile fabric shall be Mirafi 500X, or approved equivalent.

- M. Joint Sealant:
 1. Dow Corning 890-SL or approved silicone sealant conforming to ASTM D5893, C639, C1183, C679, C792, C66 and C792.
 2. Conform to Caltrans Section 41-5.02B.

- N. Backer Rod
 1. Backer Rod shall be expanded, cross linked, crossed-cell polyethylene foam compiling to ASTM D5249, Type I.
 2. Rod diameter shall be 25% greater than the saw cut joint width.

2.2 BITUMINOUS SEALS

- A. Fog Seal: Fog Seal asphaltic emulsion shall conform to Caltrans Section 37-4.02.
- B. Flush Coat: Flush Coat asphaltic emulsion shall conform to Caltrans Section 37-4.03. Sand for the flush coat shall comply with the fine aggregate grading in Caltrans Section 90-1.02C(3), sand must be free of organic material or clays.
- C. Slurry Seal: Slurry seal shall conform to Caltrans Section 37-3.02B, and be Type II unless otherwise specified.
- D. Chip Seal: Chip seal shall conform to Caltrans Section 37-2 for polymer modified asphaltic emulsion seal coat and included screenings per Caltrans Section 37-2.01B.
- E. Crack Sealant: Crack Sealant shall conform to Caltrans Section 37-6.02, Type 2, unless otherwise specified.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade and Aggregate Base:
 - 1. Prepare subgrade and over excavate per Section 31 2200 – EARTHWORK AND GRADING.
 - 2. Aggregate base shall be compacted to 95 percent ASTM D1557. Section 26-1.03E of the Caltrans Standard Specifications shall apply.
 - 3. Soil sterilant shall be applied to prepared subgrade or after installation of rock or aggregate base uniformly at the rate recommended by the manufacturer.
- B. Crack Sealing:
 - 1. Before sealing, cracks shall be cleared of dirt, dust, and all other deleterious materials to a depth of 1/4-inch to 1/2-inch.
 - 2. Cracks 1/8-inch in width and greater shall be sealed.
 - 3. Application of crack sealer shall be in accordance with the manufacturer's recommendations unless otherwise directed.

3.2 ASPHALT CONCRETE PAVING

- A. General:
 - 1. Asphalt concrete shall be proportioned, mixed, placed, spread, and compacted in conformance with Section 39 of the Caltrans Standard Specifications.
 - 2. Before placing asphalt concrete, an asphalt emulsion tack coat shall be applied to all vertical surfaces of existing pavement, curbs, gutters, construction joints, and all existing pavement to be surfaced, in conformance with Section 39 of the Caltrans Standard Specifications.
 - 3. Spreading and compacting asphalt concrete shall be performed in accordance with Section 39 of the Caltrans Standard Specifications.
 - 4. Fog seal shall be applied to all finished surfaces of asphalt concrete pavement at a rate of 0.05 gallons per square yard, in accordance with Section 37 of the Caltrans Standard Specifications.
 - 5. After fog seal has been applied, ample time shall be allowed for drying before traffic is allowed on the pavement or paint striping is applied.

3.3 CONCRETE CONSTRUCTION

- A. General:
1. All concrete shall be mixed in accordance with applicable provisions of Section 90 of the Caltrans Standard Specifications.
 2. Construction of concrete substructures shall conform to applicable provisions of Section 51 of the Caltrans Standard Specifications. Unless noted otherwise in the Specifications, all exposed surfaces of structure shall have Class 1 surface finish. Finish shall match adjacent existing concrete paving.
 3. Schedule of Locations for Concrete Finish Types, unless otherwise specified:
 - a. Slabs or Stairs to receive toppings and fills: Scratched.
 - b. Exposed Stairs Fills: Nonslip.
 - c. Exterior Paved Areas: Light Broomed.
 - d. Formed Surface to receive paint: Smooth Formed.
 - e. Concealed Concrete Surfaces: Rough Formed.
 4. Curing shall conform to provision of Caltrans Section 90-1.03B. No pigment shall be used in curing compounds for construction of concrete curbs, gutters, and structures.
 5. All work shall be subject to field inspection. No concrete shall be placed until the Program Manager has approved the forms and reinforcement.
 6. Expansion joints on curbs and gutters shall be placed 20 feet on centers, adjacent to structures, and at all returns, and shall be filled with joint filler. Control joints shall be formed 10 feet on centers.
 7. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than 6 feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.
- B. Vehicular Concrete Pavement
1. All vehicular concrete pavement shall meet the requirements of Section 40 of the Caltrans Standard Specifications.
 2. Contraction Joints shall be a minimum 1/3 of the pavement thickness.
 3. Joints shall be no less than 5 feet apart and no greater than 15 feet apart.
 4. Joints shall make rectangular panels generally square but in no case shall the dimensional ratio exceed 1.5 to 1.
 5. Timing of the joint placement is critical. Sawcut Joints must be placed as soon as the concrete can support the sawing equipment and must be completed prior to the start of volunteer cracking. The contractor is responsible for the timing of joint placement. Typical sawcut joints would be expected to be placed 4-12 hours after concrete placement.

3.4 DECOMPOSED GRANITE

- A. Compact subgrade below decomposed granite to 90% relative compaction.
- B. Sterilize soil with oxadiazon after compaction. Apply at max label rate. Apply sterilant no more than 12" outside of DG area. Soil sterilant application and DG placement shall take place during the same work day.
- C. Aggregate Base shall be spread and compacted as specified under Section 26-1.03D and Section 26-1.03E of the Caltrans Standard Specifications.
- D. Filter Fabric: Surfaces to receive filter fabric shall be free of loose or extraneous material and sharp objects that may damage filter fabric during installation.
1. Align fabric and place in a wrinkle-free manner.
 2. Overlap adjacent fabric rolls 12 to 18 inches. Rolls shall be spread in same direction: fabric shall be fastened with staples to prevent movement of fabric during placement of decomposed granite.
 3. Filter fabric damaged during placement of decomposed granite shall be repaired or replaced to meet the fabric overlap requirements.

E. Placement

1. Decomposed granite shall not be placed during rainy conditions
2. Solidifying emulsion shall be mixed thoroughly and uniformly throughout the decomposed granite per the manufacturer's instructions.

3.5 CONCRETE PAVER CONSTRUCTION

A. Installation - General

1. Concrete pavers to be clean and free of foreign materials before installation.
2. Paving work to be plumb, level and true to line and grade as shown.
3. Install pavers in pattern and layout as shown on Plans. Use string lines to hold pattern lines true.
4. Use a masonry saw to cut pavers.
5. Protection: Protect the installed concrete paver system work from damage, including sediment deposition due to subsequent construction activity on the site.
6. During the landscape maintenance period, promptly remove any pavers that settle or deviate from the grades as shown on plans.

B. Sand Bedding (Non Permeable) – Install dry sand to uniform depth required for flush finish after pavers are installed. The maximum designed depth shall be one inch thick with no sand thickness less than ¾" or more than 1 ½" except where required otherwise by Drawings. Sand is to remain undisturbed prior to the installation of unit pavers. Moisture content of sand to remain constant.

C. Open-graded Subbase and Base (Permeable)

1. Moisten, spread and compact the No. 2 subbase in 4-inch to 6-inch lifts without wrinkling or folding the geotextile.
2. For each lift, make at least two passes in the vibratory mode, then at least two in the static mode, with a minimum 10-ton vibratory roller, until there is no visible movement of the No. 2 stone. Do not crush aggregate with the roller.
3. The surface tolerance of the compacted No. 2 subbase shall be $\pm 2 \frac{1}{2}$ in. over a 10 ft straightedge.
4. Moisten, spread and compact the No. 57 base in 4-inch lift over the compacted No. 2 subbase with a minimum 10-ton vibratory roller, until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller.
5. The surface tolerance the compacted No. 57 base should not deviate more than ± 1 in. over a 10 ft straightedge.
6. Compacted density of base and subbase, per ASTM D4254, to be 95% of the laboratory index density established for the subbase and base stone.

D. No. 8 Stone Bedding (Permeable)

1. Moisten, spread and screed the No. 8 stone bedding material.
2. Fill voids left by removed screed rails with No. 8 stone.
3. The surface tolerance of the screeded No. 8 bedding layer shall be $\pm 3/8$ inches over a 10-foot straightedge.
4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.

E. Non-Permeable Paver Installation

1. Install pavers hand-tight on the undisturbed sand laying course as indicated on Plans, with tolerance from given dimensions not to exceed 3/8-inch in 100 feet.
2. Use a roller or plate vibrator with a rubber shoe to compact the pavers and to vibrate the sand into the joints between the pavers.
3. Spread joint filler sand over the installed pavers and vibrate into the joints between the pavers.
4. Sweep excess sand into the joints. Remove remaining excess sand from installed

pavers and dispose of off-site.

F. Permeable Paver Installation

1. Lay the pavers in the patterns and joint widths shown on the Plans. Maintain straight pattern lines.
2. Fill gaps at the edges of the paved area with cut units. Cut pavers to be no smaller than 1/3 of a whole unit.
3. Cut pavers and place along the edges with a masonry saw.
4. Fill the openings and joints with No. 8 stone. For paver joints that are too narrow to accept most of the No. 8 stone, use washed ASTM No. 9 or No. 10 stone as joint fill material.
5. Remove excess aggregate on the surface by sweeping pavers clean.
6. Compact and seat the pavers into the bedding material using a low amplitude, 75-90 Hz plate compactor capable of at least 4,000 lbs centrifugal compaction force. This will require at least two passes with the plate compactor.
7. Do not compact within 6 feet of unrestrained edges of the paving units.
8. Apply additional aggregate to the openings and joints, filling them completely. Remove excess aggregate by sweeping, then compact the pavers. This will require at least two passes with the plate compactor.
9. All installed pavers located 6 feet or more from the laying face must be left fully compacted at the completion of each day.
10. The final surface tolerance of compacted pavers shall not deviate more than $\pm 3/8$ under a 10 ft long straightedge.

G. Quality Control

1. The final surface elevation of pavers shall not deviate more than 3/8 in. under a 10 ft long straightedge.
2. The surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.
3. No greater than 1/8 inch difference in height between adjacent pavers.
4. Prior to applying Water-based Paver Sealer, remove any stains and efflorescence using cleaners. Apply Water-based Paver Sealer, per ICPI Tech Spec 5 and label Instructions, after final cleanup and wash down of paving stone surface. During application, protect surrounding areas from over spray. All traffic, pedestrian or vehicular, shall be kept off of sealed pavers until initial cure time has been achieved.

3.6 BITUMINOUS SEALS

A. General:

1. Mixing, spreading and placing shall be in accordance with applicable provisions of Section 37 of the Caltrans Standard Specifications.

3.7 SEALANTS AND BACKER ROD

A. General: Where indicated on the plans and/or specifications, Contractor shall seal joints with a sealant and backer rod.

1. Width and depth of joints shall meet project requirements and accommodate sealant and backer rod in conformance with Manufactures requirements.
2. Placements and shall conform to Manufactures requirements.

3.8 FIELD QUALITY CONTROL

A. Asphalt Concrete Paving:

1. Contractor shall perform a flood test in the presence of the engineer and/or District's Representative. Location of ponding greater than 1/8" in depth may impact proper drainage and shall be marked and remedied by the contractor.

2. The specified thickness of the finished pavement shown on the plans and specifications shall be the minimum acceptable.
3. Conforms shall form a smooth, pond-free transition between existing and new pavement.
4. Depressions in paving between high spots are not to exceed 1/8-inch when measured below a 10-foot long straight edged placed anywhere on surface in any direction.
5. The finished asphalt pavement shall have positive drainage without ponding.

3.9 CLEANUP

A. General:

1. Surplus material remaining upon completion of paving operations shall become the property of the Contractor, to be removed from the work site and disposed of in a lawful manner.
2. Surfaces shall be left in a clean, neat, and workmanlike condition, and all construction waste, rubbish, and debris shall be removed from the work site and disposed of in a lawful manner.

END OF SECTION

SECTION 32 1313

SITE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes the following as indicated on the Landscape drawings:
 - 1. Final subgrade preparation and paving base.
 - 2. Pedestrian concrete walks, paving, steps, ramps, seat walls, landscape retaining walls, mowing edges, and bands.
 - 3. Colored concrete finished walks and paving.
- B. Related Sections Include The Following:
 - 1. Section 31 2000 – EARTHWORK AND GRADING

1.3 REFERENCES AND STANDARDS

- A. Reference Standards apply to this Section and shall be the most current edition of the following:
 - 1. American Concrete Institute (ACI) 211.1 “Recommended Practice for Selecting Proportions for Normal Concrete.”
 - 2. ACI 301 “Specifications for Structural Concrete for Buildings.”
 - 3. ACI 302.1R “Guide for Concrete Floor and Slab Construction.”
 - 4. ACI 304 “Recommended Practice for Measuring, Mixing and Placing Concrete.”
 - 5. ACI 305 “Recommended Practice for Hot Weather Concreting.”
 - 6. ACI 306 “Recommended Practice for Cold Weather Concreting.”
 - 7. ACI 308 “Recommended Practice for Curing Concrete.”
 - 8. ACI 318 “Building Code Requirements for Reinforced Concrete.”
 - 9. American Society for Testing and Materials (ASTM) C94 “Specifications for Ready Mix Concrete.”
 - 10. ASTM Specifications referenced for materials specified herein.
 - 11. Cellular Concrete Association Guide Specification.
 - 12. ASTM 309 Liquid membrane – Forming compound for curing concrete.
 - 13. ASTM C33 “Standard Specification for Concrete Aggregates.”
 - 14. ASTM C31 “Standard Practice for Making and Curing Concrete Test Specimens in the Field.”
 - 15. California Building Code, CBC 2013, Chapter 11B for paving surface coefficient of friction and surface finish requirements for disabled access.

1.4 QUALITY ASSURANCE

- A. All site concrete work shall comply with these specifications and all applicable sections of the above named References and Standards.
- B. Design Criteria:
 - 1. Concrete: ACI 301, Chapter 3.

2. Formwork Design: The contractor shall assume all responsibility for the safety of the formwork and shall provide all necessary design, construction, materials and maintenance to produce the required concrete work safely.
- C. Record of Work: Maintain field records of time, date of placing, curing, and removal of forms of concrete in each portion of work. Such record shall be available to the Architect for examination at any time.
- D. Sample Panels: Before installing concrete work, provide sample panels, of all specified finishes, minimum 3 feet x 3 feet, using specified materials. Show color, texture, pattern, edging, and joint treatments. Correct and rebuild sample panels until Architect's acceptance of the work. Retain panels during construction as a standard for completed concrete paving work.
- E. Do not change source or brands of cement and aggregate materials during the course of the work.
- F. Concrete finisher shall have a minimum 3 years' experience finishing high-volume fly ash concrete.
- G. Slip Resistance: Concrete walk surfaces shall have a minimum wet and dry coefficient friction of 0.65 when tested in accordance with ASTM C1028.

1.5 TESTING

- A. Performed by a qualified independent testing laboratory selected and paid for by the Owner. The cost of re-testing rejected work shall be deducted from the amount due the Contractor for work under this section.
- B. All concrete subject to laboratory compression testing and slump tests.
- C. Notify the Owner forty-eight (48) hours prior to placement of concrete so the Owner's Representative can arrange to observe the taking of test cylinders if they deem it necessary.
- D. Test Methods:
 1. Sampling concrete: ASTM C172
 2. Taking cylinders: ASTM C31
 3. Testing: ASTM C39
 4. Core tests (if required): ASTM C42
 5. Slump tests: ASTM C143
- E. Slump Tests: One slump test taken for each concrete test. Reject all concrete not meeting the Drawings and Specifications.
- F. Compression Tests: Each sample for test consists of three (3) cylinders taken from each class of concrete used in each day's operation, but at least one (1) sample for test taken from each 100 cubic yards of concrete.
 1. First cylinder tested at 7 days shows 65% of the specified 28-day strength.
 2. Second cylinder tested at 28 days shows 100% of specified 28-day strength.
 3. Third cylinder will be tested if required by the DBE Representative.
- G. Doubtful Concrete:
 1. If the concrete does not conform to the requirements of ACI 318, latest edition, Section 4.3, or if 20% of the slump tests exceeds the limits shown on the Drawings, the Engineer and Owner's Representative to be notified immediately and have the right to order a change in

- the mix proportions or in the method of mixing, placing and curing of the concrete to secure the required strength and consistency for the remaining portion of the structure at no expense to the Owner.
2. Core samples at least 4 inches in diameter may be made of any doubtful concrete in representative locations selected by the Engineer. If cores meet strength requirements, the expense of coring and patching will be borne by the Owner. If tests of core specimens fail to show the strength specified, the concrete will be deemed defective and will be removed and replaced or adequately strengthened in a manner acceptable to the Owner's Representative. The cost of such removal and replacing or strengthening including cost of coring and testing and redesign as necessary is at the Contractor's expense.
 3. Remove and replace at the Contractor's expense, concrete slabs or other concrete work not properly cured and deemed unacceptable to the Owner's Representative.

1.6 SUBMITTALS

- A. Mix Designs: Submit concrete mix designs for each required concrete type. Obtain the Architect's written approval before placing concrete.
- B. Reinforcement Shop Drawings: Indicate bar sizes, spacing, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules and supporting and spacing devices.
- C. Product data:
 1. Submit complete materials list of items proposed for the work. Identify materials source.
 - a. Submit documentation of recycled content for products with specified recycled content.
 2. Submit admixture, curing compound, retarder, and accessory item product data.
 3. Submit material certificates for aggregates, reinforcing, joint fillers and sealants.
 - a. Submit documentation of recycled content for products with specified recycled content.
- D. Submit concrete delivery tickets. Show the following:
 1. Batch number.
 2. Mix by class or sack content with maximum size aggregate.
 3. Admixtures.
 4. Air content.
 5. Slump.
 6. Time of loading.
- E. Submit concrete test reports.
- F. Submit decorative exposed aggregate material samples.
- G. Submit minimum 8" x 8" colored concrete samples utilizing cement and aggregate proposed for the work.
- H. Sealants: Submit samples and test data demonstrating that the proposed sealants will adhere to the surfaces to which they will be applied.
- I. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.

3. Validation: Provide validation for the LFMs.
 - a. Recycled Content.
 - b. Regional Materials.
4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcing: Unload and store on timber skids and keep free of mud.
- B. Concrete
 1. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator or other transportation device within 1 1/2 hours, or 300 revolutions of the drum after mixing water has been added, whichever is greater.
- C. Store decorative exposed aggregates in segregated area to prevent mixing with foreign materials.
- D. Deliver curing materials, admixtures, and retarders in manufacturer's standard unopened containers with labels legible and intact. Store and protect from freezing and damage.

1.8 PROJECT CONDITIONS

- A. Work notification: Notify Architect at least 24 hours prior to installation of concrete.
- B. Establish and maintain required lines and grade elevations. Refer to notes on the grading plans and Section covering site grading and/or earth moving
- C. Environmental Requirements
 1. Cold Weather Placement: When depositing concrete when the mean daily temperatures are below 40 degrees F., comply with recommendations in ACI 306. Maintain concrete temperature at a minimum of 55 degrees F. for sections having a minimum dimension of less than 12 inches, or 50 degrees F. for sections having a minimum dimension of 12 inches or greater, for not less than 72 hours after depositing. The specified non-chloride accelerator or high early strength Type III cement may be used when approved by the Architect. Do not place concrete on days when the temperature at 9:00 a.m. is below 30 degrees F.
 2. Hot Weather Placement: When depositing concrete in hot weather, follow the recommendations in ACI 305. The temperature of concrete at time of placement shall not exceed 90 degrees F. Protect to prevent rapid drying.
- D. Do not install concrete work over wet, saturated, muddy, or frozen subgrade.
- E. Protect adjacent work.
- F. Provide temporary barricades and warning lights as required for protection of project work and public safety.

1.9 GEOTECHNICAL ENGINEER

- A. The Engineer will inspect subgrade and aggregate base prior to installation of concrete work.

1.10 LAYOUT OF THE WORK

- A. A licensed surveyor or registered civil engineer shall lay out and establish all lines, levels, grades and positions of all parts of the work.

1.11 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland cement: ASTM C150-12, Type II/V low alkali, natural color; ACI 301 2.1.
- B. Pozzolans: Coal Fly Ash: ASTM C618; Class C or Class F.
- C. Aggregate: Provide ASTM C33 normal weight aggregates, size between $\frac{3}{4}$ " and 1" and with minimum size #4, clean, uncoated crushed stone or gravel coarse aggregate free of materials which cause staining or rust spots; fine aggregate shall be clean natural sand; ACI 301 2.4, of which at least 12% passes a 50-mesh screen.
 - 1. Recycled crushed concrete aggregate, ASTM C33 may be used subject to approval by the Structural Engineer; minimum 25% desired.
- D. Water: Clean, fresh, and potable.
- E. Air-entraining admixture: ASTM C260; ACI 2.2; add as required in ACI 301 3.4.1.
- F. Water-reducing admixture: ASTM C494/A; ACI 301 2.2; Euclid, Master Builders Pozzoloth, WR Grace or equivalent.
- G. Integral concrete colorant: Light-fast, lime proof, finely divided mineral oxide terrazzo matrix coloring. Davis Colors; Solomon Co., L. M. Scofield Company or equal.
- H. The concrete shall not contain calcium chloride or admixtures containing more than 0.05% chloride ions or thiocyanates.
- I. Waterproofing admixture for water feature concrete: XYPEX Admix C-1000/C-2000.

2.2 MIXES

- A. Provide ASTM C94 ready-mixed concrete. Batch mixing at site is not acceptable; ACI 301 3.8.
 - 1. Strength:
 - a. Paving: 3,000 psi minimum at 28 days; ACI 301 3.2, ASTM C31.
 - b. All other concrete 2,500 psi minimum at 28 days; ACI 301.3.2.
 - 2. Slump range: 2" to 4" maximum; ACI 301 3.5. (3" slump for integral color concrete paving)
 - 3. Durability: ACI 301 3.4.

4. Integral concrete colorant: refer to Schedule of Landscape Construction Finishes on the drawings.
 - B. Maximize cement content of mix:
 1. Use a minimum of 15% and a maximum 35% Fly Ash content of cementitious material.
 - C. Provide an approved water-reducing admixture in all concrete. Maximum amount of water shall not exceed 45% by weight of [cement + pozzolans].
 - D. Provide an air-entraining admixture in all concrete. Air content 5% to 7%.
 - E. Indicate water added to mix at job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements.
 - F. Mixes for Washed Exposed Aggregate Concrete paving and curbs shall be Gap-Graded to maximize coarse aggregate content to attain a dense, uniform aggregate exposure.
 - G. Water feature structure and paving: add waterproofing admixture in accordance with manufacturer's printed instructions for the use intended.
- 2.3 REINFORCING STEEL (ACI 301 5.2)
- A. Use 60,000 psi yield strength for #5 and larger bars; 40,000 psi yield strength for #4 and smaller bars; conform to ASTM 615 plus (S1), Deformed Billet Steel Bars.
- 2.4 WELDED WIRE FABRIC (ACI 301 5.2.5)
- A. ASTM A185, welded plain cold-drawn steel wire fabric; 6"x 6", w 1.4 x w 1.4.
- 2.5 ACCESSORIES
- A. Aggregate Base Course: Untreated base courses shall be installed under paving where indicated in the Drawings. Material shall be 1-1/2 inch maximum size broken stone or crushed gravel conforming to the requirements of Class 2 aggregate base of Section 26-1 of the State Specifications.
 - B. Joint Filler: ASTM D1752 Type I, premolded non-extruding neoprene sponge rubber, thickness indicated; with removable polystyrene or PVC strip mechanically attached to the top edge.
 - C. Expansion Joint Dowels: No. 4 smooth steel dowels; cover one end with capped cardboard dowel sleeve.
 - D. Curing Compound: ASTM C309, non-yellowing, non-staining liquid membrane-forming type containing a fugitive dye. Chlorinated rubber compounds not acceptable for exterior use.
 - E. Joint Sealants: Two-component polysulfide or polyurethane elastomeric type complying with FS TT-S-00227, self-leveling, designed for foot traffic.
 - F. Cleavage Membrane/Vapor Barrier: 10 mil; black, polyvinyl chloride sheet; fungus resistant.
 - G. Form Release Agent: Non-staining chemical form release agent free of oils, waxes, and other materials harmful to concrete.

- H. Use one of the following:
 - 1. Embedded Abrasive Strips: Wooster Products Supergrit Nosing Type 630A, 3" wide x 1/4" thick; with sure hold anchor. OR
 - 2. Carborundum Abrasive Step Nosing:
 - a. Silicone Carbide 80 grit: National Abrasive 415/351-3163.
 - b. Sil-Mar S870 Resin: Sil-Mar Cultured Marble, Inc., 415/285-5995.
- I. Wood Dividers: Pressure treated Douglas Fir: Select Structural; S4S; eased edges; air dried and treated with pentachlorophenol, A.W.P.A. C 2, 0.60 pcf.
- J. Lightweight Fill Material
 - 1. Expanded Polystyrene (EPS), type 1X, ASTM C578-87a.
 - 2. Density 2.00 pcf, ASTM C303, D1622.
 - 3. Compressive Strength (10% deformation) 25-33 psi.
 - 4. Board thickness: 1", 2" and 4" as required.
- K. Prefabricated Drainage Composite: Three dimensional waffle pattern, high impact polymeric sheet with geotextile backing sheet. Compressive strength 15,000psi; Miradrain 6000 or equal.
- L. Rebar Supports: 100% recycled plastic.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which the concrete work is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. All foundation bearing surfaces shall be inspected and approved by the Geotechnical Engineer prior to start of formwork.
- C. All formwork and reinforcing shall be reviewed and approved by the Architect prior to placement of concrete.

3.2 LINES AND LEVELS

- A. Finished grades shown on Plans are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.
- B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10 foot straightedge. There shall be no pools of water standing on the pavement after a rain.
- C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.
- D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.
- E. Horizontal layout shall not vary more than 1 inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.3 PREPARATION

- A. Preparation of Subgrade: specified in Section 31 2000 – EARTHWORK AND GRADING.
- B. Aggregate Base
 - 1. Install under paving where indicated on the Drawings.
 - 2. Do not install until subgrade has been approved by the Geotechnical Engineer.
 - 3. Spread the aggregate base on the prepared subgrade to such a depth that when thoroughly compacted it will conform to the grades and dimensions shown on the Drawings. Spread and compact in accordance with Section 26-1 of the State Specifications. The finished surface shall be smooth, hard, and true to line and grade.
- C. Remove loose material and debris from base surface before placing concrete.

3.4 FORMWORK AND REINFORCING

- A. General: Conform with ACI 301, Chapter 4.
- B. Install, align, and level forms. Stake and brace forms in place. Maintain following grade and alignment tolerances:
 - 1. Top of form: Maximum 1/8" in 10'-0".
 - 2. Vertical face: Maximum 1/4" in 10'-0".
- C. Construct formwork carefully so that straight lines are perfectly tangent to radii, curves are smooth and flowing, and transitions between changes in vertical gradient of curbs, walls, walks and paving are smooth and gradual with no abrupt or sharp changes.
- D. Coat form surfaces in contact with concrete with form release agent. Clean forms after each use and coat with form release agent as necessary to assure separation from concrete without damage.
- E. Chamfer Strips: Where chamfered edges are indicated on the drawings, install wood chamfer strips in the forms; tooling of chamfers will not be allowed.
- F. Locate, place, and support reinforcement as indicated on the Drawings.
 - 1. Paving:
 - a. Provide a single layer of welded wire fabric in all concrete slabs-on-grade, paving and walks unless otherwise indicated.
 - b. Where indicated on the Drawings, provide reinforcing bars in concrete paving.
 - 2. Provide reinforcing bars in walls, curbs, steps, and other locations indicated, adequately supported and secured to prevent displacement.
- G. Install, set, and build-in work furnished under other specification sections. Provide adequate notification for installation of necessary items.
- H. Install pipe sleeves for irrigation system furnished under Section 32 8100. Stake location of irrigation sleeves.

3.5 INSTALLATION

- A. Concrete Placement: (ACI 301 5.5.3)
 - 1. Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.
 - 2. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing. In cold weather comply with ACI 306, "Recommended Practice

- for Cold Weather Concreting". In hot weather comply with ACI 305, "Recommended Practice for Hot Weather Concreting."
3. Moisten base to provide a uniform dampened condition at the time concrete is placed. Verify manholes or other structures are at required finish elevation and alignment before placing concrete.
 4. Place and spread concrete to the full depth of the forms. Use only square-end shovels or concrete rakes for hand-spreading and consolidating concrete. Exercise care during spreading and consolidating operations to prevent segregation of aggregate and dislocation of reinforcement.
 5. Free fall shall not exceed eight (8) feet in walls and columns, or five (5) feet in other elements.
 6. Place concrete in a continuous operation between expansion joints. Provide construction joints when sections cannot be placed continuously.
 7. Place concrete in one course, monolithic construction, for the full width and depth of concrete work. Provide minimum 4-inch-thick walks and paving, except as otherwise indicated.
 8. Strike-off and bull-float concrete after consolidating. Level ridges and fill voids. Check surface with a 10'-0" straightedge. Fill depressions and refloat repaired areas. Darby the concrete surface to provide a smooth level surface ready for finishing.
 9. Do not clean concrete trucks and equipment on site; use a previously-designated approved site that meets environmental regulation.

3.6 JOINTS

- A. Construction Joints: locate and install where indicated, or if not indicated, so as to not impair the strength and appearance of the structure.
 1. Provide keyways at least 1-1/2 inch deep in joints in walls and between walls and footings.
 2. Use preformed metal construction joints in paving and slabs.
- B. Control Joints in retaining walls and seat walls: install vertical V-joints formed with 3/4" beveled wood chamfer strips spaced at 10 feet on center minimum, and at changes in direction. Align joints with adjacent paving joints and markings.
- C. Expansion Joints:
 1. Scope: install expansion joints in the following locations, whether shown on the drawings or not:
 - a. Concrete paving: minimum 20' O.C. and at all intersections.
 - b. At vertical surfaces: install joints without dowels at all building walls and other vertical structures.
 2. Hold joint filler straight, true to line and at proper level by stapling to 2X wood form; pour adjacent slabs separately.
 3. Neatly tool edges of joint flush with removable strip.
 4. Carefully remove the removable strip when concrete is sufficiently set.
 5. Avoid sprawling tooled joint edges; any damaged edges shall be repaired to the satisfaction of the Architect.
- D. Score Marks:
 1. Tool or saw-cut score marks as indicated on the drawings.
 2. Tool straight lines with neatly formed radius edges; conform with details shown on the Drawings.
 3. Saw-cut straight lines continuous to vertical surfaces

3.7 FINISHES

- A. Perform concrete finishing using mechanical or hand methods as required. Finishes shall match approved samples.

- B. Integral Color Concrete:
 - 1. Do not use magnesium floats or tools.
 - 2. Do not use visquine for curing.
 - 3. Do not allow excessive surface water.
- C. Upon completion of floating, and after bleed water has disappeared and concrete can sustain foot pressure with nominal indentation, cut concrete away from forms. Work edges with an edging tool. Round edges to 1/4" radius.
- D. Paving to Receive Broom Finish:
 - 1. Screed and float paving to a smooth, even grade in accordance with the Drawings using overhead screeds where necessary to establish flow lines or grade breaks.
 - 2. Steel trowel to a smooth, hard finish.
 - 3. Using a stiff broom, strike clean, crisp broom marks across paving at right angles to the length of the ramp.
 - 4. Finish shall be uniform throughout in color and texture.
- E. Curbing, Headers, Bands and Dividers:
 - 1. Neatly tool edges as detailed on the Drawings.
 - 2. Bring exposed surfaces to a hard, smooth steel trowel finish and then finish with a fine hair broom to produce a uniform crisp, light broom finish parallel to the length of headers and dividers.
 - 3. Finish of curb faces shall match finish of tops.

3.8 SEALANTS

- A. Work under this Section includes furnishing and installation of all sealants, backing rods, primers and associated work and materials in expansion joints in concrete work.
- B. Prime joints and install per manufacturers printed instructions.
- C. Hold sealant flush with paving surface.
- D. Sealant shall be smooth with no voids or irregularities.

3.9 REPAIR OF SURFACE DEFECTS (ACI 301 9.1)

- A. Patching of tie holes is required.

3.10 CURING (ACI 301 12.1)

- A. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.
- B. Apply curing compound in accordance with manufacturer's printed instructions.

3.11 FIELD QUALITY CONTROL (ACI 301, Chapter 16)

- A. Provide field quality control testing and inspection during concrete operations.
- B. Contractor shall provide adequate notice, cooperate with, provide access to the work, obtain samples, and assist test agency and their representatives in execution of their function.
- C. Testing:

1. Provide slump test on first load of concrete delivered each day and whenever requested due to changes in consistency or appearance of concrete.
2. Strength testing:
 - a. Provide 1 set of 3 test specimens for each 50-cu. yd. placed in any one day. Secure samples in accordance with ASTM C172 and mold specimens in accordance with ASTM C31.
 - b. Test 1 specimen at 7 days and 2 specimens at 28 days in accordance with ASTM C39.
 - c. Furnish copies of field records and test reports as follows:
 - 2 copies to Architect
 - 1 copy to Contractor
 - 1 copy to Ready Mix Supplier
3. Record the exact location of the concrete in the work represented by each set of cylinders and show on test reports.
4. Provide an insulated moist box for protection of the test cylinders until shipped to the laboratory.

3.12 MISCELLANEOUS CONCRETE REQUIREMENTS

- A. All other concrete work indicated on the drawings and/or required to complete all the work, shall be provided and installed, even though not specifically mentioned herein.

3.13 PROTECTION

- A. Protect concrete work from damage due to construction and vehicular traffic until final acceptance. Exclude construction and vehicular traffic from concrete pavements for at least 14 days.

3.14 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work.
- B. Remove all bituminous materials, form release agents, curing compounds or other materials employed in the work which would prevent proper application of sealants, liquid water proofing or other specified treatments.
- C. Remove from site all excess materials, debris, and equipment. Repair damage resulting from concrete operations.
- D. Repair any damage done to adjacent work to the satisfaction of the Owner.

END OF SECTION

SECTION 32 1315

PERVIOUS CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS SUMMARY

- A. The Work to be completed under this contract includes the furnishing of all labor, materials and equipment necessary for construction of Portland Cement Pervious Concrete Pavement for streets, parking & pedestrian areas in conformance with the plans and specifications.

1.2 SUMMARY

- A. Drawings and general provisions of the Contract, including Contract General Conditions and Supplementary General Conditions, Contract Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Work specified in Related Sections;
 - 1. Section 31 2200 – EARTHWORK AND GRADING.

1.3 REFERENCES

- A. American Concrete Institute
 - 1. ACI 305 “Hot Weather Concreting”
 - 2. ACI 522 “Report on Pervious Concrete”
 - 3. ACI Flatwork Finisher Certification Program
 - 4. ACI Field Technician Certification Program
- B. American Society for Testing and Materials
 - 1. ASTM C29 “Test for Bulk Density (Unit Weight) and Voids in Aggregate”
 - 2. ASTM C33 “Specification for Concrete Aggregates”
 - 3. ASTM C42 “Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.”
 - 4. ASTM C94 Specification for Ready-Mixed Concrete
 - 5. ASTM C117 “Test Method for Material Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.”
 - 6. ASTM C138 “Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete.”
 - 7. ASTM C140 “Test Methods for Sampling and Testing Concrete Masonry Units and Related Units”.
 - 8. ASTM C150 “Specification for Portland Cement”
 - 9. ASTM C172 “Practice for Sampling Freshly Mixed Concrete”
 - 10. ASTM C260 “Specification for Air-Entraining Admixtures for Concrete”
 - 11. ASTM C494 “Specification for Chemical Admixtures for Concrete”
 - 12. ASTM C595 “Specification for Blended Hydraulic Cements”
 - 13. ASTM C618 “Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.”
 - 14. ASTM C989 “Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
 - 15. ASTM C1077 “Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.”
 - 16. ASTM C 1602 “Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete”

17. ASTM D1557 "Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)."
18. D3385 "Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer."
19. ASTM E329 "Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."

1.4 QUALITY ASSURANCE

- A. Prior to award the contractor shall submit evidence of two successful Pervious Concrete Pavement projects including but not limited to the following:
 1. Project name and address, owner name and contact information
 2. Test results including density (unit weight), void content and thickness.
- B. The Pervious Concrete Contractor shall meet, at the time of bidding, one of the following criteria and submit verification of NRMCA certification.
 1. The Contractor shall employ no less than one NRMCA Certified Pervious Concrete Craftsman who must be onsite, overseeing each placement crew during all pervious concrete placement, or:
 2. The Contractor shall employ no less than three NRMCA Certified Pervious Concrete Installers who have received hands-on training in the construction of pervious concrete pavements. The certified personnel must be onsite, working as members of the placement crew, during all pervious concrete placements.
- C. At least one member of the crew shall be a Certified Concrete Finisher in accordance with the criteria of the American Concrete Institute.
 - a. SPECIAL EQUIPMENT: Pervious concrete requires specific equipment for compaction and jointing. The pavement shall be jointed and compacted using the methods listed.

1.5 SPECIAL EQUIPMENT: Pervious concrete requires specific equipment for compaction and jointing. The pavement shall be jointed and compacted using the methods listed.

- A. Rolling compaction shall be achieved using a minimum 10-inch diameter steel pipe that spans the width of the section placed (and exerts a vertical pressure of at least 10 psi on the concrete).
- B. Plate compaction shall be achieved using a standard soil plate compactor that has a base area of at least two square feet and exerts a minimum of 10 psi vertical pressure on the pavement surface.
- C. When joints are placed in pervious pavements, they may be constructed by rolling, forming or sawing. Rolled joints shall be formed using a "salt roller" to which a beveled fin with a minimum depth of 1/4 the thickness of the slab has been welded around the circumference of a steel roller. Score joints shall be constructed using an early entry or wet saw.
 - a. SUBMITTALS: Prior to commencement of the work the contractor shall submit the following:

1.6 SUBMITTALS: Prior to commencement of the work the contractor shall submit the following:

- A. Concrete materials:
 1. Proposed concrete mixture proportions including all material weights, volumes, density (unit weight), water cement ratio, and void content.
 2. Aggregate type, source and grading.
 3. Cement, fly ash and admixture manufacturer certifications

- B. Qualifications: Evidence of qualifications listed under Quality Assurance.
 - C. Project details: Specific plans, details, schedule, construction procedures and quality control plan.
 - D. Subcontractors: List all materials suppliers and subcontractors to be used on the project.
- 1.7 TEST PANELS: Prior to construction, test panel(s) shall be placed and approved by the District. The District is permitted to waive this requirement based on contractor qualifications.
- A. Test panel(s) shall be constructed in accordance with the plans and specifications. A minimum 225 sq. ft. panel size shall be placed, jointed and cured using materials, equipment, and personnel proposed for the project.
 - B. Test panel(s) cost and removal shall be the responsibility of the Contractor.
 - C. Quality: Test panels shall have acceptable surface finish (as determined by the District's Representative), joint details, thickness, porosity and curing procedures and shall comply with the testing and acceptance standards listed in the Quality Control section of this specification.
 - D. If test panels placed at the site are found to be deficient in thickness, density (unit weight) or percentage of voids, or of an unacceptable appearance, they shall be removed at the contractor's expense and taken to an approved landfill or recycling facility. If test panels are found to be satisfactory, they may be left in-place and included in the completed work.

PART 2 – MATERIALS

2.1 CEMENT

- A. Cement Type II or V conforming to ASTM C150 or Portland cement Type IP or IS conforming to ASTM C595.

2.2 SUPPLEMENTARY CEMENTITIOUS MATERIALS:

- A. Class F Fly ash conforming to ASTM C618.
- B. Ground Iron Blast-Furnace Slag conforming to ASTM C989.

2.3 CHEMICAL ADMIXTURES:

- A. Air entraining agents shall comply with ASTM C260.
- B. Chemical Admixtures shall comply with ASTM C494.
- C. Hydration stabilizers are permitted to be used when it is necessary to increase concrete placement time to 90 minutes and improve finishing operations.

2.4 AGGREGATES:

- A. Coarse aggregate shall comply with ASTM C33. Size 8 (3/8" to No. 16) or Size 89 (3/8 in. to No. 50) shall be used unless an alternate size is approved for use based on meeting the project requirements. Fine aggregate complying with ASTM C33, if used, shall not exceed 3 cu. ft.

- B. Larger aggregate sizes may increase porosity but can decrease workability. Avoid well graded aggregates as they may reduce porosity, and may not provide adequate void content.
- C. Where available, natural rounded aggregates are recommended.

2.5 WATER

- A. Water shall comply with ASTM C 1602.

2.6 MIXTURE PROPORTIONS: The composition of the proposed concrete mixtures shall be submitted to the [District's/Owner's] Representative for review and/or approval and shall comply with the following provisions unless an alternative composition is demonstrated to comply with the project requirements.

- A. Cementitious Content (combination of cement and supplementary cementitious content): The concrete producer shall determine the cement content based upon the available aggregate gradation.
- B. Supplementary cementitious content: Fly ash: 25% maximum. Slag: 50% maximum
- C. Water/Cementitious Ratio: The concrete producer shall determine the water/cement ratio based upon the available aggregate gradation.
- D. Aggregate Content: The bulk volume of aggregate per cubic yard shall be equal to 27 cubic foot when calculated from the dry rodded density (unit weight) determined in accordance with ASTM C29 jiggling procedure.
- E. Admixtures: Admixtures shall be used in accordance with the manufacturer's recommendations and dosage determined by the pervious contractor and concrete producer.
- F. Mix Water: The quantity of mixing water shall be established to produce a pervious concrete mixture of the desirable workability to facilitate placing, compaction and finishing to the desired surface characteristics.

2.7 BASE COURSE LAYER: Shall be ASTM No. 3 or 57.

2.8 OPTIONAL RESERVOIR COURSE LAYER: Shall be ASTM No. 2, 3 or 57.

PART 3 – EXECUTION

3.1 SUBGRADE:

- A. Subgrade preparation per Section 31 2200 – EARTHWORK AND GRADING.
- B. Permeability: Subgrade shall have a minimum permeability of 0.5 inch per hour determined in accordance with ASTM D3385, or provide subdrainage system.

3.2 FORMWORK:

- A. Form materials are permitted to be of wood or steel and shall be of width to the depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations. When a mechanical vibratory screed is used for placement,

forms shall have a removable spacer of 1/2" thickness placed above the depth of pavement. The spacers shall be removed following placement and vibratory strike-off to allow roller compaction.

3.3 MIXING AND HAULING:

- A. Production: Pervious concrete shall be manufactured and delivered in accordance with ASTM C 94.
- B. Mixing: Mixtures shall be produced in central mixers or in truck mixers. When concrete is delivered in agitating or non-agitating units, the concrete shall be mixed in the central mixer for a minimum of 1.5 minutes or until a homogenous mix is achieved. Concrete mixed in truck mixers shall be mixed at the speed designated as mixing speed by the manufacturer for 75 – 100 revolutions.
- C. Transportation: The pervious concrete mixture may be transported or mixed on site and discharge of individual loads shall be completed within one (1) hour of the introduction of mix water to the cement. Delivery times may be extended to 90 minutes when a hydration stabilizer is used.
- D. Discharge: Each truckload will be visually inspected for consistency of concrete mixture. Job site water additions are permitted to obtain the required mix consistency. Discharge shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practical and such that discharged concrete is incorporated into previously placed plastic concrete.

3.4 PLACING AND FINISHING:

- A. The Contractor shall provide equipment to place the pervious concrete. Internal vibration shall not be permitted. Placement procedures shall utilize a motorized hydraulic roller screed or a mechanical vibratory truss screed. In small inaccessible areas, strike-off by non-vibratory means shall be permitted. Wooden 2x4 screeds are not be permitted.
 - 1. Hydraulic Roller Screed Construction: The hydraulic roller screed is a metal tube that is hydraulically spun counter-clockwise to the direction of travel. The concrete shall be placed on grade in front of the roller screed from either a mixer truck or a belt conveyor.
 - 2. Compaction shall be achieved by successive passes of the roller screed over the concrete. Placed concrete shall not be disturbed while in the plastic state. Low spots after the screeding operation shall be filled and rolled.
 - a. The compacted concrete shall be cross rolled to remove any screeding and compaction marks on the concrete surface.
 - b. Hand tampers shall be used to compact the concrete along the slab edges immediately adjacent to the forms. After edging with a 1/2" radius edger, no further finishing shall be performed on the concrete. The pervious concrete pavement shall be compacted to the required cross-section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
 - c. The pervious concrete pavement shall be compacted to the required cross-section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
 - 3. Mechanical Vibratory Screed Construction: A conventional vibratory truss screed shall ride on a 1/2" spacer placed on top of the pavement form. The concrete shall be placed on grade in front of the vibratory screed from either a mixer truck or a belt conveyor.
 - a. After the concrete has been screeded to the top of the spacer, the spacer shall be removed and the concrete compacted to the top of the form with a steel pipe spanning the section being placed. The steel pipe shall be a

minimum of 10" diameter exerting a minimum pressure of 10 psi on the concrete. Low spots after the screeding operation shall be filled and rolled. Care shall be taken during the compaction process to not seal the pervious concrete surface.

- b. The compacted concrete shall be cross rolled to remove any screeding and compaction marks on the concrete surface.
 - c. Hand tampers shall be used to compact the concrete along the slab edges immediately adjacent to the forms. After edging with a ½" radius edger, no further finishing shall be performed on the concrete.
 - d. The pervious concrete pavement shall be compacted to the required cross-section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
- B. Temperature at time of placement shall be between 40°F and 80°F.

3.5 JOINTING

- A. Joints shall be placed at regular intervals equivalent to the width of the pavement. Joints can be precluded at the option of the District.
- B. Control (contraction) joints shall be installed at regular intervals not to exceed 20 feet, or two times the width of the pavement. The control joints shall be installed to a depth of T/4. These joints shall be installed in the plastic concrete or saw cut after the concrete has partially hardened or reached a green state.
- C. Jointing plastic concrete: Joints installed in the plastic concrete shall be constructed utilizing a joint cross-roller. Rolled joints shall be installed in the plastic concrete immediately after compaction and prior to curing.
- D. Jointing hardened concrete: Saw-cuts shall be made as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking. The curing cover in the vicinity of the joint shall be removed and the surface kept misted to prevent moisture loss during the sawing operation. After sawing the curing cover shall be securely replaced for the remainder of the curing cycle.
- E. Transverse construction joints: Transverse construction joints shall be installed whenever placing is suspended for 20 minutes or whenever concrete is no longer workable.
- F. Longitudinal joints between successive placements shall not be dowelled.
- G. Isolation joints: Isolation joints shall be used when abutting fixed vertical structures such as light pole bases, building foundations, existing pavement, etc. Isolation material shall be positioned before concrete is placed and shall be the full depth of the pavement section.

3.6 CURING

- A. Immediately after screeding, if the pervious concrete is susceptible to plastic shrinkage according to ACI 305, the surface shall be kept moist and evaporation prevented using a spray applied curing compound and/or evaporation retarder.
- B. Final curing procedures shall begin no later than 20 minutes after the concrete has been discharged from the mixer. The pavement surface shall be covered with a minimum of six (6) mil thick white or clear polyethylene sheets or other approved covering material. The

cover shall overlap all exposed edges and shall be secured to prevent dislocation due to winds or adjacent traffic conditions.

- C. The curing cover shall remain securely in place for a minimum of 7 days. No vehicular traffic shall be permitted on the pavement until curing is complete and no truck traffic shall be permitted for at least 14 days. In cold weather black plastic may be used to aid in heat retention.

3.7 QUALITY CONTROL

- A. The [District/Owner] shall employ a testing laboratory that conforms to the requirements of ASTM E329 and ASTM C1077. All personnel engaged in testing shall be certified by the American Concrete Institute as ACI Concrete Field Technicians or equivalent and shall be certified by NRMCA as a Pervious Concrete Technician.
- B. Traditional Portland cement pavement testing procedures based on strength and slump control are not applicable to this type of pavement material.
- C. Concrete tests shall be performed for each 150 cubic yards or fraction thereof with a minimum of one test for each day's placement.
- D. Plastic concrete shall be sampled in accordance with ASTM C 172 and density (unit weight) measured in accordance with ASTM C 138. The density (unit weight) of the delivered concrete shall be +/- 5 pcf of the design density (unit weight) when determined using the rodding method of ASTM C29 using a 0.25 cf container.
- E. Plastic void content shall be calculated as per ASTM C138, Gravimetric Air Determination and compared to the void percentage required by the hydraulic design.
- F. Hardened concrete shall be tested for in-place infiltration rate. The infiltration rate shall not be less than 100 inches per hour when tested using the procedure described in paragraph 3.7.G.1. At the District Representative's option concrete shall also be tested for in-place thickness and void content. One set of three cores per 150 CY of concrete placed on one day or fraction thereof shall be drilled in accordance with ASTM C 42].
- G. The infiltration test shall be performed in accordance with the following procedure:
 - 1. The apparatus shall consist of a:
 - a. One gallon, minimum size, water container with a spout. The spout shall be able to produce a stream with a circular cross-section and large enough in diameter to discharge the entire contents of the container in 20 seconds or less.
 - b. Stopwatch capable of indicating elapsed time to the nearest second.
 - c. Tape measure of at least 0.95 m (36 inches) that is graduated in 5 mm (1/4 inch) increments or smaller.
 - d. The water shall be free of suspended solids. The volume of water shall be determined to two significant figures
 - e. The testing procedure is:
 - i. Place a pre-measured amount of water into the container.
 - ii. Pour the water onto the pervious concrete surface. Control the discharge rate by manually adjusting the angle of the spout so that the pooling of water on the concrete surface is between 25.4 cm to 76.2 cm (10 to 30 inches). Pour the entire contents of the container onto one spot and hold the spout over the spot until the pool of water vanishes.

- iii. Start the stopwatch when the water initially touches the concrete surface and stop it when the pool disappears from the surface.
 - iv. Measure the longest dimension of the dampened area. Measure the width of the pool perpendicular to the first measurement.
 - v. Repeat this procedure in a minimum of 4 separate locations.
- f. The calculation of the Infiltration Capacity shall be as follows:
- i. The formula for SI Units is: $IC = (V) (14.4 \times 10^6) / (\pi) (d_1) (d_2) (t)$ inches per hour.
 - ii. The formula for U.S. Standard Measures is: $IC = (V)(3,326,400) / (\pi)(d_1)(d_2)(t)$ inches per hour
Where: IC is Infiltration Capacity, V is the volume of water in gallons or liters, and d1 and d2 are the dimensions that were determined in part iv. Pi is approximately 3.14159.
- g. The test report shall include at a minimum:
- i. The time and date of testing.
 - ii. The name and affiliation of the person performing the test.
 - iii. The location of the site being tested.
 - iv. The location of each site tested.
 - v. The volume of water used at each test site.
 - vi. The length of the two measurements taken at each site.
 - vii. The discharge time for the water at each location.
 - viii. The infiltration capacity at each location.
 - ix. The average infiltration capacity for the site.
- H. The cores when measured for length shall not be more than $\frac{3}{4}$ -inch less than the specified design thickness.
- I. The cores shall be tested for void content using the following procedure:
- 1. Weight of saturated, surface-dry (ssd) specimen in air, B
 - 2. Weight of ssd specimen in water, C
 - 3. Determine bulk specific gravity (ssd), $B/(B-C)$
 - 4. Weight in water of ssd specimen wrapped in parafilm or saran wrap, D
 - 5. Volume of core wrapped in parafilm or saran wrap by displacement, $B-D = V_c$
 - 6. Volume of solid part of core (aggregate), $B-C = V_s$
 - 7. Percentage of permeable voids, $((V_c - V_s)/V_c) * 100$

END OF SECTION

SECTION 32 1443

POROUS UNIT PAVING

PART 1 - GENERAL

1.1 DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Permeable interlocking concrete pavers.
 - 2. Crushed stone leveling course.
 - 3. Base aggregate.
- B. Related Sections include the following:
 - 1. Section 32 1313 – SITE CONCRETE

1.3 REFERENCES AND STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
 - 3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 4. C 936, Standard Specification for Solid Interlocking Concrete Pavers.
 - 5. C 979, Specification for Pigments for Integrally Colored Concrete.
 - 6. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
 - 7. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
 - 8. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
 - 9. D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
 - 10. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 11. Interlocking Concrete Pavement Institute (ICPI)
 - 12. Permeable Interlocking Concrete Pavement manual.
 - 13. Permeable Design Pro software for hydrologic and structural design
 - 14. C33 Specification for Concrete Aggregate
 - 15. D2940 Standard Specification for graded aggregate material for bases.

1.4 SUBMITTALS

- A. Paver manufacturer's/installation subcontractor's drawings and details: Indicate layout, pattern and relationship of paving joints to fixtures, and project formed details.
- B. Minimum 3 lb. (2 kg) samples of subbase, base and bedding aggregate materials.

- C. Sieve analysis of aggregates for subbase, base and bedding materials per ASTM C 136.
- D. Project specific or producer/manufacturer source test results for void ratio and bulk density of the base and subbase aggregates.
- E. Soils report indicating density test reports, classification, and infiltration rate measured on-site under compacted conditions, and suitability for the intended project.
- F. Permeable concrete pavers:
 - 1. Paver manufacturer's catalog sheets with product specifications.
 - 2. Four representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.
 - 3. Accepted samples become the standard of acceptance for the work of this Section.
 - 4. Laboratory test reports certifying compliance of the concrete pavers with ASTM C 936.
 - 5. Manufacturer's certification of concrete pavers by ICPI as having met applicable ASTM standards.
 - 6. Manufacturers' material safety data sheets for the safe handling of the specified paving materials and other products specified herein.
 - 7. Paver manufacturer's written quality control procedures including representative samples of production record keeping that ensure conformance of paving products to the product specifications.
- G. Paver Installation Subcontractor:
 - 1. Demonstrate that job foremen on the project have a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
 - 2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.
 - 3. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.
- H. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFM's.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 1. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.5 QUALITY ASSURANCE

- A. Paver Installation Subcontractor Qualifications:
 - 1. Utilize an installer having successfully completed concrete paver installation similar in design, material and extent indicated on this project.
 - 2. Utilize an installer with job foremen holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

- B. Review the manufacturers' quality control plan, paver installation subcontractor's Method Statement and Quality Control Plan with a pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner's representative.
- C. Mock-Ups:
 - 1. Install a 10 ft x 10 ft (3 x 3 m) paver area.
 - 2. Use this area to determine surcharge of the bedding layer, joint sizes, and lines, laying pattern, color and texture of the job.
 - 3. This area will be used as the standard by which the work will be judged.
 - 4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
 - 5. If mock-up is not retained, remove and properly dispose of mock-up.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle.
 - 1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
 - 2. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift.
 - 3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction.
- D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install in rain or snow.
- B. Do not install frozen bedding materials.

1.8 MAINTENANCE

- A. Extra materials: Provide 10% additional material for use by owner for maintenance and repair.
- B. Pavers shall be from the same production run as installed materials.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Pacific Interlock Pavingstone, Contact: 831-578-4978
- B. Permeable Interlocking Concrete Paver Units:
 - 1. Paver Type: Hydro-Flo Paver.
 - a. Material Standard: Comply with ASTM C 936.
 - b. Pattern: as shown on plans
 - c. Color Pigment Material Standard: Comply with ASTM C 979, see landscape drawings for specific color.
 - d. Sizes: as shown on plans

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Permitted for gradations for crushed stone jointing material, base and subbase materials. Base and subbase materials shall have a minimum 0.32 void ratio. All substitutions shall be approved in writing by the project engineer.

2.3 CRUSHED STONE FILLER, BEDDING, BASE AND SUBBASE

- A. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C 131, minimum CBR of 80% per ASTM D 1883.
- B. Do not use rounded river gravel.
- C. All stone materials shall be washed with less than 1% passing the No. 200 sieve.
- D. Joint/opening filler, bedding, base and subbase: conforming to ASTM D 448 gradation as shown in Tables 1, 2 and 3 below:

Table 1
ASTM No. 8 Grading Requirements
Bedding and Joint/Opening Filler

Sieve Size	Percent Passing
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16)	0 to 5

Table 2
ASTM No. 57 Base Grading Requirements

Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Site Verification of Conditions:
 - 1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
 - 2. Compaction of the soil subgrade is optional and should be determined by the project engineer. If the soil subgrade requires compaction, compact to a minimum of 95% standard Proctor density per ASTM C 698. Compacted soil density and moisture should be checked in the field with a nuclear density gauge or other test methods for compliance to specifications. Stabilization of the soil and/or base material may be necessary with weak or continually saturated soils, or when subject to high wheel loads. Compaction will reduce the permeability of soils. If soil compaction is necessary, reduced infiltration may require drainpipes within the open-graded subbase to conform to local storm drainage requirements.
 - a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
 - b. Provide written density test results for soil subgrade to the Owner, General Contractor and paver installation subcontractor.
 - c. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage pipes and inlets.
 - 3. Do not proceed with installation of bedding and interlocking concrete pavers until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.2 PREPARATION

- A. Verify that the soil subgrade is free from standing water.
- B. Stockpile joint/opening filler, base and subbase materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

3.3 INSTALLATION

- A. Subgrade: specified in the Earth Moving specification section.
- B. General
 - 1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the subbase materials.
 - 2. Keep area where pavement is to be constructed free from sediment during entire job. Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
 - 3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.
- C. Open-graded base
 - 1. Moisten, spread and compact the No. 57 base layer in one 4 in. (100 mm) thick lift. On this layer, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (10 T) vibratory roller until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller.

2. The surface tolerance of the compacted No. 57 base should not deviate ± 1 in. over a 10-foot straightedge.
 3. Compaction Equipment a. Use a smooth dual or single smooth drum, minimum 10 ton (10 T) vibratory roller or a minimum 13,500 lbf (60 kN) centrifugal force, reversible vibratory plate compactor that provides maximum compaction force without crushing the aggregate base.
- D. Bedding layer
1. Moisten, spread and screed the No. 8 stone bedding material.
 2. Fill voids left by removed screed rails with No. 8 stone.
 3. The surface tolerance of the screeded No. 8 bedding layer shall be $\pm 3/8$ in (10 mm) over a 10 ft (3 m) straightedge.
 4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.
- E. Permeable interlocking concrete pavers and joint/opening fill material
1. Lay the paving units in the pattern(s) and joint widths shown on the drawings. Maintain straight pattern lines.
 2. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.
 3. Cut pavers and place along the edges with a double-bladed splitter or masonry saw.
 4. Fill the openings and joints with $1/4$ " chipped stone.
 5. Remove excess aggregate on the surface by sweeping pavers clean.
 6. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf (22 kN) centrifugal compaction force. This will require at least two passes with the plate compactor.
 7. Do not compact within 6 ft (2 m) of the unrestrained edges of the paving units.
 8. Apply additional aggregate to the openings and joints if needed, filling them completely. Remove excess aggregate by sweeping then compact the pavers. This will require at least two passes with the plate compactor.
 9. All pavers within 6 ft (2 m) of the laying face must be left fully compacted at the completion of each day.
 10. The final surface tolerance of compacted pavers shall not deviate more than $\pm 3/8$ (10 mm) under a 10 ft (3 m) long straightedge.
 11. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.4 FIELD QUALITY CONTROL

- A. After sweeping the surface clean, check final elevations for conformance to the drawings.
- B. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.
- C. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
- D. Bond lines for paver courses: $\pm 1/2$ in. (± 15 mm) over a 50 ft (15 m) string line.

3.5 PROTECTION

- A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

- B. PICIP installation contractor shall return to site after 6 months from the completion of the work and provide the following as required: fill paver joints with stones, replace broken or cracked pavers, and re-level settled pavers to initial elevations. Any additional work shall be considered part of original bid price and with no additional compensation.

END OF SECTION

SECTION 32 1540

CRUSHED STONE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Aggregate Base
 - 2. Redwood Headers
 - 3. Metal Headers
 - 4. Decomposed Granite Paving with Binder
 - 5. Ornamental Gravels

1.2 RELATED WORK

- A. Section 31 2000 – EARTHWORK AND GRADING

1.3 REFERENCES AND STANDARDS

- A. Standard Specifications: Where referred to in these Specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.
- B. Percent Compaction: As referred to in these Specifications, percent compaction or relative compaction is required in- place dry density of material expressed as a percentage of the maximum dry density of the same material determined in accordance with the ASTM Test Method D-1557-78 (C). Optimum moisture content is the moisture content corresponding to the maximum dry density determined by the ASTM Test Method D-1557-78 (C).
- C. American Society for Testing and Materials, (ASTM).

1.4 QUALITY ASSURANCE

- A. Decomposed Granite paving shall comply with these specifications and all applicable sections of the above-named references and standards.
- B. Installation: Performed only by skilled workmen with satisfactory record of performance on completed projects of comparable size and quality.
- C. Sample Panel: Before starting crushed gravel paving, provide a sample panel including redwood headers. Build panel at the site of full thickness and approximately 4 feet x 4 feet. Correct and rebuild sample panel until Architect's acceptance of the work. Retain panel during construction as a standard for completed paving work.
- D. Do not change source of ornamental gravels or decomposed granite during the course of the work.

1.5 SUBMITTALS

- A. Submit manufacturer's product data, specifications and samples of each gravel.

- B. Submit the following material samples for the Resident Engineer's written approval prior to delivery of materials to site, or preparation of sample panel. Provide suppliers sieve analysis with each sample.
 - 1. Base Course: one-half cubic foot.
 - 2. Surface Course: one-half cubic foot.
- C. Submit material certificates for base materials.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFM's.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store loose granular materials in a well-drained area on a solid surface to prevent mixing with foreign materials.

1.7 PROJECT CONDITIONS

- A. Review installation procedures and coordinate paving work with other work affected by crushed gravel paving work.
- B. Protect partially completed paving against weather damage when work is not in progress.
- C. Provide temporary barricades and warning lights as required for protection of project work and public safety.
- D. Protect adjacent work from damage, soiling, or staining during paving operations.

1.8 GEOTECHNICAL ENGINEER

- A. The Engineer will inspect subgrade and aggregate base prior to installation of paving.

1.9 LAYOUT OF THE WORK

- A. A licensed surveyor or registered civil engineer shall lay out and establish all lines, levels, grades and positions of all parts of the work.

1.10 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.

- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 DECOMPOSED GRANITE

- A. Permeable Base: 1-1/2-inch maximum size broken stone or crushed gravel conforming to requirement for Class 2 Permeable Base, Section 26-1 of the State Specifications.

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
#4	25-40
#8	18-33
#30	5-15
#50	0-7
#200	0-3

- B. Base Course: 3/4" Class 2 granite aggregate base material per State Specifications; color: Gold/tan.

- C. Surface Course: decomposed granite; color: Gold/tan. Maximum dry density: 130 pcf, optimum moisture: 8.8%.

Sieve Size	Percent Passing
#4	85-100
#8	55-80
#30	30-45
#200	10-20

2.2 BINDER

- A. Non-toxic, premium organic soil additive; "PHP Organic Binder" a natural, colorless and odorless binding material for decomposed granite fines available from TMT Enterprises, 408.432.9040 or equal.

2.3 MIX DESIGN

- A. Base Course and Surface Course: 12 pounds Stabilizer per 1 ton of crushed and decomposed granite.
- B. Thoroughly mix in a batch mixer.
- C. Binder to have a minimum swell volume of 35 ml/gm.

2.4 ACCESSORIES

- A. Redwood Headers:
1. C.R.A. Construction Heart California Redwood; rough.
 2. Stakes: Construction Heart Redwood or pressure treated Douglas Fir.
 3. Nails: Galvanized.

- B. Metal headers:
 - 1. Aluminum edging 3/16"x 4" Cleanline.
 - 2. Permaloc Corp. (800) 356-9660 or equal.
 - 3. Color to be black.
- C. Soil Sterilizer: Granular weed growth inhibiting type herbicide, labeled for use under pavement surfaces. Material shall not damage trees and plants adjacent to pavement surfaces.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which paving is to be installed. Notify the Resident Engineer, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 LINES AND LEVELS:

- A. Finished grades shown on Plans are given in feet and decimals of feet and are to be the top of all graded or paved surfaces. Slope uniformly between given spot elevations unless otherwise indicated.
- B. Surfaces shall be true to within 1/8 inch when tested in any direction with a 10-foot straightedge. There shall be no pools of water standing on the pavement after a rain.
- C. Transition between changes in vertical gradient of walks and paving shall be smooth and gradual with no abrupt or sharp changes.
- D. Horizontal curves and radii shall be laid out tangent to adjacent straight lines or adjacent compound curves. Curves shall be smooth and flowing.
- E. Horizontal layout shall not vary more than 1 inch from dimensions indicated on the Drawings. Make minor field adjustments in the layout as necessary to make radii tangent and curves smooth and flowing as indicated on the Drawings.

3.3 PREPARATION OF SUBGRADE

- A. Preparation of subgrade: specified in Section 31 2000 – EARTHWORK AND GRADING.

3.4 WEED CONTROL

- A. Apply soil sterilizer over subgrade prior to installing paving in accordance with the manufacturer's printed instructions.

3.5 INSTALLATION

- A. Redwood Headers
 - 1. Install headers true to line and grade as indicated on the Drawings.
 - 2. Sharp radii may be constructed of laminated material to the thickness of header board indicated on the Drawings.
 - 3. Stakes shall be a minimum 14 inches long (increase length as necessary per soil conditions for solid anchorage) at 4 feet on center.
 - 4. Double stake corners and splices.
 - 5. Securely nail stakes to headers with galvanized nails.

B. Metal Headers

1. Preparation: Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line of edging with string or other means to assure border straightness and curves as designed. Dig trench 1 inch (25 mm) deeper than set of edging bottom.
2. Set edging into trench with top at 1/2 inch (12.7 mm) above compacted finish grade on turf side with side having loops for stakes placed on opposite side of turf. Drive stakes through edging loops until locked in place. Requires 5 stakes evenly spaced for each 16 feet (4.88 meters) section, or 3 stakes evenly spaced for each 8 feet (2.44 meters) section for a total of 8 stake loops available in each 16 feet (4.88 meters) section if necessary. Provide additional stakes at approximately 24 inches apart, longer stakes, heavier gage stakes, or any combination of previously mentioned as necessary to firmly secure edging for permanent intended use.
3. Where edging sections turn at corners and at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.

C. Placement and Compaction

1. General: Uniformly spread approved material and compact to grades and lines shown. Compaction shall be made by power rollers to 95%. Each lift shall be compacted separately immediately after placement. Apply water as required.
2. Permeable Base Rock: Place over prepared subgrade and compact to depth shown. Finish to a tolerance of +/-1".
3. Base Course: Place over permeable base rock, and compact to depth shown. Finish to a tolerance of +/- 1/4".
4. Surface Course: Scarify base course immediately prior to placement of surface course to provide a bond between the two lifts. Place surface material over base course and compact to depth shown.
5. When surface areas have been rolled and it becomes necessary to add thin layer of material to bring surface to grade, previously rolled or compacted area shall be scarified to provide bond with added material.
6. Finish surface of walks shall be uniform in appearance as to texture and color, and shall have a firm stable consistency, resistant to erosion.

3.6 PROTECTION

- A. Restrict traffic from paving surfaces during and until completion of installation.

3.7 CLEANING

- A. Perform cleaning during installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from crushed stone paving operations.

END OF SECTION

SECTION 32 1723

PAVEMENT MARKING

PART 1 – GENERAL

1.1 SUMMARY:

- A. Provide requirements for materials, fabrications, and installation of traffic control and pavement markings.

1.2 SUBMITTALS:

- A. Submit manufacturer's product data describing application of products and compliance with VOC requirements.
- B. Shop Drawings: Show complete layout and location of pavement markings prior to demolition or obliteration of the existing markings.
- C. Submit samples as follows:
 1. Traffic paint.
 2. Pavement markers and adhesives.
 3. Reflectorized markers and posts.

1.3 DELIVERY, STORAGE AND HANDLING:

- A. Comply with Division 1 requirements and specifications.
- B. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of installation.
- C. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

PART 2 – PRODUCTS

2.1 MATERIALS:

- A. Traffic Marking and Symbol Paint:
 1. Traffic Marking and Symbol Paint shall conform to the applicable requirements of Caltrans Standard Specification Section 84-2.02C.
 2. Physical Characteristics shall conform to the following:

Volatile Organic Compounds	100 g/l max
Pigment (White) Content, by Weight	58-62%
Pigment (Yellow) Content, by Weight	56-60%
Total Nonvolatile Content, by Weight	75-79%

3. EF Series, Fast Dry, Waterborne Traffic Paint distributed by Ennis Flint (Product Code PTWB01WH, Color Fed 595 White 37925); (Product Code PTWB01YLF, Color Lead Free Yellow 33538); or approved equivalent.

- B. Accessible Symbol Background Paint: Blue Color. Glidden Co. "Glid-Guard Lifemaster Finish No. 5200 /series, Color 1/M 79", or approved equivalent.
- C. Thermoplastic Stripes and Markings:
 - 1. Thermoplastic stripes and markings shall be hot applied conforming to Caltrans Standard Specification Section 84 and shall be Cataphote-Catatherm brand, Pavemark thermoplastic brand, or approved equivalent.
 - 2. Thermoplastic stripes and markings shall include glass beads to meet retroreflective requirements of Caltrans Section 84-2.02A and 84-2.02B
- D. Glass beads shall be per Caltrans Section 84-2.02D.
- E. Pavement Markers and Adhesives:
 - 1. Pavement markers shall be two-way retroreflective markers and shall conform to the applicable requirements of Caltrans Standard Specification Section 81.3.02C.
 - a. Pavement Marker: For fire hydrants shall be blue.
 - b. Pavement Marker: For lane delineation shall be per plan.
 - 2. Adhesive for pavement markers shall be standard set epoxy adhesive conforming to the requirements of Caltrans Standard Specification Section 95-1.02F.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine receiving surfaces and verify that surfaces are clean and proper for installation.
- B. Do not start work until unsatisfactory conditions have been corrected.

3.2 APPLICATION:

- A. Preparation:
 - 1. Clean and prepare surfaces to receive traffic paint in accordance with Caltrans Standard Specification Section 84-2.03B and these special provisions. Where required, remove existing striping and markings by wet blasting or equivalent method. Do not use dry sandblasting or other dust producing methods.
- B. Traffic Paint:
 - 1. Traffic paint shall be machine applied in accordance with Caltrans Standard Specification Section 84-2.03C.
 - 2. No paint shall be applied until the surface has been approved by the Engineer and until at least 10 days after the slurry seal on asphalt concrete has been placed. Place markers in accordance with Caltrans Standard Specification Section 81-3.03.
- C. Striping Layout:
 - 1. Layout striping locations via "cat tracking" or chalk line for District approval prior to application of any markings or paint.
 - 2. Traffic stripe shall be single and double, solid and broken, and of the color to match existing conditions.
 - 3. Traffic striping shall be placed in patterns to match existing conditions, contractor shall document.
- D. Thermoplastic Stripes and Markings:

1. Thermoplastic stripes and markings shall be applied hot in conformance with manufacturer's recommended instructions and the applicable requirements of Caltrans Standard Specification Sections 84-2.03B and 2.03C.
- E. Pavement Markers:
1. Pavement markers shall be installed to delineate the location of fire hydrants along off-site and on-site roadways. No markers shall be installed until the surface has been approved by the Engineer and until at least 10 days after the slurry seal on asphalt concrete has been placed. Place markers in accordance with Caltrans Standard Specification Section 81-3.03
- F. Apply marking paint in accordance with approved manufacturer's recommendations.
- G. Density of paint coverage shall hide color and texture of substate.
- H. Parking Stripes: Paint four inches wide unless otherwise noted.
- I. Symbol Marking: Paint to match existing conditions.
- 3.3 CLEANING AND PROTECTION:
- A. Comply with requirements of Section 01 7000 – Contract Closeout.
 - B. Upon completion of work, remove surplus materials and rubbish and clean off spilled or splattered paint resulting from this work.
 - C. Permit no surface traffic until pavement and symbol marking has dried thoroughly.

END OF SECTION

SECTION 32 3113

CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Chain Link Fencing and Gates as indicated on the Landscape Drawings.
 - 2. Chain Link Fencing and Gates with slats as indicated on the Landscape Drawings.

1.3 RELATED WORK

- A. Section 32 1313 – SITE CONCRETE

1.4 REFERENCES AND STANDARDS

- A. Federal Specifications (FS).
- B. Chain Link Fence Manufacturer's Institute's (CLFMI).
- C. Steel Chain Link Galvanized Fence Fabric (CS 246).
- D. Industrial Steel Specifications for Fence-Posts, Gates, and Accessories.
- E. American Society for Testing and Materials, (ASTM).

1.5 QUALITY ASSURANCE

- A. Chain link fencing and gates shall conform to these specifications and all applicable sections of the above-named references.
- B. Provide chain link fences and gates as complete units produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.
- C. Installation: Performed only by the manufacturer or an experienced chain link fence installer approved by the manufacturer.

1.6 SUBMITTALS

- A. Submit manufacturer's product data for each type of fencing and finish required.
- B. Submit shop drawings. Include plan layout and details illustrating height, location, and sizes of posts, rails, braces, gates, and anchorage. Provide hardware list and erection procedures. Include a layout drawing showing the spacing of all posts and location of all gates; abrupt changes in grade; and all corner, gate, anchor, end and pull posts.

- C. Submit the following material samples in required finish:
 - 1. Fabric, 6" square.
 - 2. Slat color
- D. Submit installer's certification that furnished materials meet specification requirements.
- E. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFM's.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver chain link fence materials in the manufacturer's original packaging with tags and labels intact and legible.
- B. Handle and store material to prevent damage and deterioration.

1.8 PROJECT CONDITIONS

- A. Do not begin chain link fencing installation until final grading has been completed and approved by the Architect.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Master Halco, 800-966-4513, or equal.

2.2 ACCEPTABLE INSTALLERS

- A. Calco Fencing Company, Livermore, California; 925.449.5081.
- B. AAA Fence Company, Santa Clara, California; 408.727.5465.

2.3 MATERIALS

- A. Chain Link Fabric: One-piece width, full height up to 12'- 0", 2" diamond mesh, 9-gauge (0.148") steel wire.
 - 1. Aluminized or Zinc-coated finish.
 - 2. Aluminized: ASTM A-491, coated before weaving with minimum 0.4 ounces of aluminum per square foot of surface area, ASTM A817.
 - 3. Zinc Coated Finish: ASTM A 392, Class 2, 2.0 ounces zinc per sq. ft. of surface. Coated after fabric fabrication.
 - 4. Selvages: Top selvages knuckled and bottom selvages twisted.
 - 5. Finish: Natina Steel Solution, 866-959-8421
 - a. Reactive color treatment solution that naturally reacts with galvanized metal to develops into a mottled and rustic, brown finish.
 - b. Solution to be natural, environmentally safe, and non-toxic.

- B. Framework: Steel Pipe.
 - 1. Schedule 40 steel pipe with zinc coating, ASTM F1043 Group 1A and F1083, not less than 2.0 ounces zinc per sq. ft. of surface.
 - 2. Pipe Size O.D. Weight Lbs/l.f.

1.660"	2.27
1.900"	2.72
2.375"	3.65
2.875"	5.79
3.500"	7.58
4.000"	9.11
 - 3. Finish: Natina Steel Solution, 866-959-8421
 - a. Reactive color treatment solution that naturally reacts with galvanized metal to develops into a mottled and rustic, brown finish.
 - b. Solution to be natural, environmentally safe, and non-toxic.

- C. Hardware and Accessories: Provide manufacturer's standard hardware and accessories, except as otherwise indicated.
 - 1. Finish and Coating: As specified for framework.

2.4 COMPONENTS

- A. Fence Posts:

Fabric height	Line O.D.	Terminal/Corner O.D.
to 6'	1.900"	2.375"
6' to 9'	2.375"	2.875"
9' to 12'	2.875"	4.000"

- B. Gate Posts:

Single Gate Width	Double Gate Width	Post O.D.
to 6'	to 12'	3.500"
6' to 12'	13' to 25'	4.000"

- C. Top and Brace Rails: 1.660" O.D.
 - 1. Provide continuous top rails in manufacturer's longest lengths, with expansion type couplings for each joint. Provide necessary fittings for attaching top rail to each gate, corner, pull, and end post.

- D. Gate Frames: 1.900" O.D.

- E. Bottom Rail: 1.660" O.D.

- F. Post Braces: Provide bracing assemblies, for fences 6'-0" high or over, at each end and gate posts, and at both sides of corner and pull posts.
 - 1. Locate 1.900" horizontal brace at mid-height of fabric.
 - 2. Use 0.375" diameter rod with turnbuckle for diagonal truss.

2.5 ACCESSORIES

- A. Finish to match framework.
- B. Post Caps: Weather tight pressed steel or cast-iron closure caps, 1 top for each post. Provide tops with openings to accommodate top rails.
- C. Sleeves, stretcher bars, stretcher bar bands, clips, ties, rail ends, fasteners, fittings, and accessories: Provide manufacturer's standard complying with CLMI specifications. Finish matching framework finish.
- D. Concrete: ASTM C94 ready-mixed concrete, minimum 28-day compressive strength of 2,500 psi, air-entrained 2% to 4%.
- E. Non-Shrink Grout: Embeco 153, as manufactured by Master Builders.
- F. Slats: Flat/Slat '1000' high density polyethylene self-locking slats.
- G. Hardware Cloth: 1/2" x 1/2" x 36", 19 gauge, hot dipped galvanized after weaving.

2.6 GATES

- A. Fabricate gate perimeter frames of steel pipe members assembled by welding or with special fittings at corners. Provide additional horizontal and vertical members to ensure proper operation and for attachment of fabric, hardware, and accessories.
- B. Gate Fabric: Metal and finish matching fence fabric.
- C. Gate Hardware: Provide manufacturer's standard hardware, complete with latches, stops, keepers, and hinges complying with CLMI specifications. Provide hardware of sufficient design and strength for satisfactory gate operation.
 - 1. Hinges: Galvanized pressed steel or malleable iron to suit gate size, nonlift-off type, offset to permit 180-degree gate opening. Provide 1 pair of hinges for each leaf of each gate.
 - 2. Latch Assembly for Double Gates: Provide center drop-rod type latch assembly to permit operation from either side of gate. Provide padlock eye as integral part of the latch assembly requiring one padlock for locking both gate leaves.
 - 3. Latch Assembly for Single Gates: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
 - 4. Gate Stops: Provide gate stops consisting of mushroom type or flush plate type with anchors, to be set in concrete to engage the center drop-rod.
 - 5. Keeper: Provide keeper, which automatically engages the gate leaf and holds it in the open position until it is manually released, for all gate leaves.
 - 6. Padlock: Provide one padlock for each gate. Padlocks shall conform to FS FF-P-101E (1) and as follows: Type EPC, Size 2-inches (solid brass body), 6 pin tumbler mechanism, stainless steel spring extension type shackles with 2-inch clearance, 2 nickel-chrome plated keys per padlock.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which chain link fencing is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Contractor shall secure all field measurements required for proper and adequate fabrication and installation of the work covered by this section. Exact measurements are the Contractor's responsibility.
- B. Provide sleeves and inserts for imbedment in other work and templates and measurements for their placement.
- C. Lay out complete fence line.
- D. Locate and mark post positions. Space line posts equally and at maximum 10'-0" on center spacing, unless otherwise indicated on the drawings.
- E. Provide corner posts at positions where fence changes direction more than 10 degrees.

3.3 INSTALLATION

- A. Install the chain link fence system in accordance with the manufacturer's installation instructions and complying with CLMI specifications.
- B. Provide a rigid, plumb, finished fence structure with fabric tight and in tension; of the heights indicated on the drawings.
- C. Drill post footing holes into firm, undisturbed, or compacted earth.
 - 1. Footing diameter: Minimum 3 times the post diameter.
 - 2. Footing depth: Minimum 3" deeper than the post setting depth.
 - 3. Post depth: Minimum of 36" depth.
 - 4. Gate post depth: In accordance with manufacturer's recommendations for gate size indicated, minimum of 48" depth.
 - 5. Remove excavated posthole soil from the site.
- D. Install gate, end, corner, pull, and line posts in concrete foundations.
 - 1. Where posts are in paving, set post footings to allow paving to cover the footing.
- E. Place foundation concrete and tamp for consolidation. Align each post both vertically and laterally. Hold in position during concrete placement and finishing operation.
 - 1. Trowel finish tops of footings, and slope to direct water away from posts.
 - 2. Set keeps, stops, sleeves, and other accessories into concrete as required.
 - 3. Grout-in posts set into sleeved holes with non-shrink grout.
- F. Top Rails: Install continuously through post caps or extension arms.
- G. Center Rails: Provide center rails where required.
- H. Brace Assemblies: Install brace assemblies where required.
- I. Bottom Rails: Install bottom rails between posts with fittings and accessories.

- J. Stretch fabric tight between terminal posts. Install on security side of fence, and anchor securely to framework.
 - 1. Position bottom of fabric maximum of 2" above ground level at each post.

- K. Cut fabric to form continuous piece between terminal posts.
 - 1. Pull the fabric taut and clip or tie to posts, top rail, and bottom tension wire.
 - 2. Do not splice fabric.
 - 3. Anchor to framework so that the fabric remains in tension after the pulling force is released.
 - 4. Bend wire ties to minimize hazard to persons.
 - 5. Peen bolt threads to prevent removal of nuts. Bolts shall not protrude more than ¼ inch beyond nuts after tightening. File rough edges smooth. All posts shall be plumb and rigid after installation. Rails shall be straight and tight. Chain-link fabric shall be smooth and uniformly stretched tight and straight.

- L. Install gates plumb, level, and secure for full opening without interference.
 - 1. Adjust hardware for smooth operation.
 - 2. Lubricate where necessary.

3.4 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all debris and equipment. Repair all damage resulting from chain link fence system installation.

END OF SECTION

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SECTION 32 3116

WELDED WIRE FENCING AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All labor, materials and appurtenances necessary for installation of the commercial welded wire architectural fence systems as indicated on the Landscape Drawings.
 - 1. Property line fencing
 - 2. Utility enclosure fencing and gates

1.2 RELATED WORK

- A. Section 31 2000 – EARTHWORK AND GRADING
- B. Section 32 1313 – SITE CONCRETE

1.3 REFERENCES AND STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2453/F 2453M – Standard Specification for Welded Wire Mesh Fence Fabric

1.4 QUALITY ASSURANCE

- A. Welded wire fence systems and gates shall conform to these specifications and all applicable sections of the above-named references.
- B. Provide welded wire fence systems and gates as complete units produced by a single manufacturer including necessary erection accessories, fittings and fastenings.

- C. Installation: Performed only by the manufacturer or an experienced chain link fence installer approved by the manufacturer.

1.5 SUBMITTALS

- A. Submit manufacturer's product data for each type of fencing and finish required.
- B. Submit shop drawings. Include plan layout and details illustrating height, location, and sizes of posts, rails, braces, gates, and anchorage. Provide hardware list and erection procedures. Include a layout drawing showing the spacing of all posts and location of all gates; abrupt changes in grade; and all corner, gate, anchor, end and pull posts.
- C. Submit the following material samples in required finish:
 - 1. Welded wire fence fabric, 6" square.
- D. Submit installer's certification that furnished materials meet specification requirements.
- E. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFMs.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver welded wire fence & gate materials in the manufacturer's original packaging with tags and labels intact and legible.
- B. Handle and store material to prevent damage and deterioration.

1.7 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Master Halco, 800-966-4513, or equal.

2.2 MATERIALS

- A. Wire mesh:
 - 1. Welded Wire, 2" x 4" x 48", 14 gauge
 - 2. Zinc coated finish: ASTM A 121, A116, and A641, Class 3, 0.80 oz of zinc per sq. ft. of surface. Coated after fabric fabrication.
 - 3. Finish: Natina Steel Solution, 866-959-8421
 - a. Reactive color treatment solution that naturally reacts with galvanized metal to develops into a mottled and rustic, brown finish.
 - b. Solution to be natural, environmentally safe, and non-toxic.

- B. Posts:
 - 1. T-Posts:
 - a. Galvanized, heavy weight, 1.33/FT agricultural T-Post
 - b. Finish: Natina Steel Solution, 866-959-8421
 - 1. Reactive color treatment solution that naturally reacts with galvanized metal to develops into a mottled and rustic, brown finish.
 - 2. Solution to be natural, environmentally safe, and non-toxic.
 - 2. Wood Posts:
 - a. 3-1/2" to 4" Dia Treated Pine Posts
 - b. Tapered Blunt End
 - c. MCA Preservation Treatment

- C. Hardware and Accessories: Provide manufacturer's standard hardware and accessories, except as otherwise indicated.
 - 1. Finish and Coating: As specified for framework.

2.3 ACCESSORIES

- A. Sleeves, stretcher bars, stretcher bar bands, clips, ties, rail ends, fasteners, fittings, and accessories: Provide manufacturer's standard. Finish matching framework finish.

- B. Hardware Cloth: 1/2" x 1/2" x 36", 19 gauge, hot dipped galvanized after weaving.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

- A. Contractor shall secure all field measurements required for proper and adequate fabrication and installation of the work covered by this section. Exact measurements are the Contractor's responsibility.

- B. Lay out complete fence line.

- C. Locate and mark post positions. Fence post spacing shall be as shown on drawings.

- D. Provide corner posts at positions where fence changes direction more than 10 degrees.

- E. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36". Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces:
 1. Remove all metal shavings from cut area.
 2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.

3.4 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION

SECTION 32 3126

WIRE FENCES AND GATES PLANT SUPPORT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Welded wire grid panels, including gate panels.
 - 2. Panel channel and angle trim.
 - 3. Panel posts.
 - 4. Necessary clips, straps and spacers.
 - 5. Powdercoat finish.
- B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 RELATED WORK

- A. Section 32 9300 - PLANTING

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog details for specified products demonstrating compliance with referenced standards. Provide list of fittings being provided with descriptions and either photographs or drawings for each type.
- B. Shop Drawings: Submit Shop Drawings for fabrication and installation. Include the following:
 - 1. Plans, elevations, and detail sections showing sizes, critical dimensions, panel layout constraints using a 2 x 2 inch modular grid, and details and locations of accessories.
 - 2. Indicate materials, methods, finishes, fittings, fasteners, anchorages, and accessory items.
- C. Verification Samples: Two samples representing actual products and finishes as follows:
 - 1. Welded wire grid panel, 6 in. x 6 in., with one edge of channel trim and one edge of angle trim, all as one unit.
 - 2. Color Submittals: Submit metal chips, 2 in. x 3-1/2 in. minimum, showing color and texture to be provided.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFMs.

- a. Recycled Content.
- b. Regional Materials.
4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum 5 years experience in manufacturing and supplying welded wire panel systems of the type required for this Project.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect materials from damage. Store panels flat. Provide edge protection when strapping is used. Do not apply loads to panel edges.
- B. Inspect products upon delivery in order to submit timely freight claim for any damaged materials.
- C. Store products in manufacturer's packaging until ready for installation.
- D. Handle and store products according to manufacturer's recommendations. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- E. Exercise care not to scratch, mark, dent, or bend metal components during delivery, storage, and installation.

1.7 PROJECT CONDITIONS

- A. Verify actual openings by field measurements before fabrication; show recorded measurements on shop drawings.
- B. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

- A. The welded wire panel plant support system and accessories shall have completed an ISO Compliant 14040/44, third party verified Life Cycle Assessment (LCA).

2.2 ACCEPTABLE MANUFACTURER

- A. greenscreen®, 725 S. Figueroa St. Suite 1825, Los Angeles, CA 90017; Tel: 1-800-450-3494; sales@greenscreen.com, www.greenscreen.com.

2.3 PANELS

- A. Panels shall be rigid, three dimensional welded wire grid fabricated of 14 gage galvanized steel wire.
 - 1. Metallic-Coated Steel Wire: Welded-wire, galvanized in accordance with ASTM A641.
- B. Face Grid: Wires shall be welded at each intersection to form a 2 x 2 inch face grid on the front and back of panels,
- C. Trusses: Face grids shall be separated by bent wire trusses spaced at 2-inch centers and welded to front and back face grids at each truss apex.
- D. Thickness: As shown on Drawings.
- E. Length and Width: As indicated on the Drawings.
- F. Tolerance: 1/8 inch in width and 1/8 inch in length.

2.4 ACCESSORIES

- A. Trim:
 - 1. Fabricate from 20-gage ASTM A879 galvanized steel.
 - 2. Types:
 - a. Channel Trim: Thickness of panel x ½ inch legs.
 - b. Angle Trim: ½ inch x ½ inch legs.
 - 3. Locations:
 - a. As indicated on the Drawings.
- B. Clips and Straps: Provide manufacturer's standard types of clips and straps suitable for mounting conditions. Fabricate from ASTM A879 galvanized steel. Adjustable clips shall have ¼ inch diameter 18-8 stainless steel bolt, washer, and nut.
- C. Fence Posts: 3-inch square ASTM A500, Grade B steel tube. The steel strip used in the manufacture of the post shall conform to ASTM A1011. Minimum yield strength shall be 45,000 psi. Provide steel post caps. Overall post length shall be as indicated on the Drawings.
- D. Fasteners for Mounting Clips to Fence Posts: Self drilling, self tapping hex washer head screws, with strength of Type 410 stainless steel, and corrosion resistance of Type 304 stainless steel.

2.5 FABRICATION

- A. Cut to size.
- B. Weld trim to panels and grind smooth exterior surfaces of welds.
- C. Curved Panels: All curved panels shall be fabricated in the factory using approved "Cut-to-Curve" or "Crimped-to-Curve" procedures as recommended by manufacturer for diameter of curve and conditions of use prior to application of powder coat finish to ensure that all wire

edges are coated and protected. The use of "Cut-to-Curve" or "Crimped-to-Curve" fabrication technique is dependent on the specific radius and the direction of the curve relative to the flat panel layout.

2.6 FINISH

- A. Metal components (except fasteners) shall receive commercial grade finish system after fabrication.
- B. Finish System:
 - 1. Pretreat with general purpose, alkaline, water based cleaner / degreaser applied at 240 degrees F.
 - 2. Prime with fusion bond epoxy powder coat.
 - 3. Topcoat with [TGIC] polyester or polyester-urethane powder coat with a minimum total dry film thickness of not less than [6 mils (0.15 mm)].
- C. Salt Spray Resistance: Finish shall remain rust free when tested 1680 hours in accordance with ASTM B117.
- D. Finish and Color: Powdercoat Bronze.
- E. Touch-Up Paint: Provide high quality, exterior-grade spray paint suitable for conditions of use.

2.7 WARRANTY

- A. Standard 1-year warranty is available from the date of substantial completion or 18 months from the date of shipment, whichever comes first. greenscreen® warrants against defects in workmanship and materials that would result in failure under intended application and use as exterior fabricated wall grillage. "Failure" is defined as structural failure of the wire of sufficient incidents in any panel that would result in the panel not performing in a structural or safe manner under the intended application and use. Installation is excluded. Contact greenscreen® for further information, and extensions.

2.8 MISCELLANEOUS MATERIALS

- A. Concrete: Normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines and posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Division 01 Section "Execution".
- B. Verify alignment, support dimensions, and tolerances are correct.
- C. Inventory components to ensure all required items are available for installation. Inspect components for damage. Remove damaged components from site and replace.

3.3 INSTALLATION - GENERAL

- A. Spans: For freestanding fences and screens, span between structural supports should not exceed 8' for 3" thick panels without thorough review of specific site conditions and mounting details. For overhead horizontal or inclined panels span between structural supports should not exceed 4'. All curved panel spans should be reviewed based on specific panel radius and center to center of proposed structural support spacing.
- B. Install panels plumb and square, centered within area designated for panels, and aligned to maintain modular grid.
- C. Avoid cutting panels in field. Where field cutting is essential, clean and dry area and apply touch-up paint to cut edges.
- D. Install securely with fasteners located to meet manufacturer's requirements.
- E. Repair bent or damaged panels. If panels cannot be repaired to satisfaction of Architect, remove from jobsite and replace with new panels.

3.4 INSTALLATION

- A. Install welded wire panel plant support system by setting posts as indicated on the Drawings and fastening panels to posts according to manufacturer's written instructions.

3.5 ADJUSTING AND CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Clean installed products in accordance with manufacturer's instructions before Owner's acceptance.
- B. Do not use abrasive cleaners.
- C. Remove from project site and legally dispose of construction debris associated with this work.

3.6 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Protect installed products and finished surfaces from damage during construction.
- D. Replace defective or damaged components as directed by Architect.

3.7 PLANT INSTALLATION

- A. Refer to Section 32 9300 - PLANTING.

END OF SECTION

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SECTION 32 8100

IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work in this section consists of furnishing, layout and installing an irrigation system complete, including certification of irrigation system installation as required by the State of California Model Water Ordinance.
- B. Related work specified elsewhere includes:
 - 1. Section 31 2000, EARTHWORK
 - 2. Section 32 9300, PLANTING

1.2 CALIFORNIA MODEL WATER EFFICIENT LANDSCAPE ORDINANCE REQUIREMENTS

- A. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances.
- B. Pursuant to the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall submit a Certification of Installation to the Local Jurisdiction/water purveyor as described in the construction documents and these specifications. Certification shall at a minimum include the following documents:
https://planning.smcgov.org/sites/planning.smcgov.org/files/documents/files/Performance_MWE_LOSubmittalChecklist.pdf
 - PART 1. Project Information Sheet
 - PART 2. Certification of Installation according to the landscape documentation package
 - PART 3. Irrigation Scheduling and Controller Programming
 - PART 4. Schedule of Landscape and Irrigation
 - PART 5. Landscape Irrigation Audit Report
 - PART 6. Soil Management/Analysis Report with verifying implementation, see Planting Specification for analysis requirements.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Specifications: Follow manufacturer's current printed specifications and drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the drawings.
- B. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
- C. References, Codes and Standards:

1. State of California Model Water Efficient Landscape Ordinance
 2. California Environmental Quality Act (CEQA)
 3. Water Use Classification of Landscape Species (WUCOLS).
 4. American Society of Irrigation Consultants (ASIC) Design Guidelines.
 5. California Landscape Standards, California Landscape Contractors Association, (CLCA) Sacramento, California.
 6. CAL-OSHA, title 8, Subchapter 4-Construction Safety Orders and Subchapter 7-General Industry Safety Orders.
 7. California Electric Code.
 8. California Plumbing Code (UPC) published by the Association of Western Plumbing Officials.
 9. NFPA 24, Section 10.4, Depth of Cover.
 10. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.
 11. American Society of Testing Materials (ASTM).
- D. Furnish without extra charge any additional material and labor when required by the compliance with all above mentioned codes and regulations, though the work be not mentioned in these specifications or shown on the drawings.
- E. Reclaimed Water: If reclaimed water is to be utilized, contractor to provide all pipe, equipment, signage and other warnings for reclaimed as required by local agency regulations.
- F. Experience: Assign a full-time employee to the job as supervisor for the duration of the Contract who is a certified landscape technician, and has an irrigation certification through CLCA or minimum of four (4) years experience in landscape irrigation installation.
- G. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner's Representative.
- H. Explanation of Drawings:
1. Due to the scale of the Drawings, it is not possible to indicate all piping offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affected by all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities and architectural features.
 2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in arc dimensions exist that might not have been considered in engineering. Bring such obstruction or differences to the attention of the Owner's Representative. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.
 3. Notify and coordinate irrigation work with applicable contractors for location and installation of piping and sleeves through or under walls, pavement and structures.
- I. Coordinate plant locations with emitter locations.
1. Adjust plant locations in relation to the emitters as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
 2. Coordinate planting and irrigation and provide hand watering of emitter irrigated and drip irrigated areas as required to maintain moist root zones until end of plant establishment period.
- J. Coordinate with owner to properly train and familiarize the Owner's Representative for the proper operation and maintenance of the irrigation system to ensure plants thrive, see I.S.C. as a reference.

1.4 SUBMITTALS, in accordance with Section 01 3300.

- A. Materials & Equipment Submittal:
1. Submit all materials and equipment in a single submittal package.
 2. Submit required copies of the cut sheets and a complete list of materials proposed for installation, along with any proposed substitutions clearly identified and obtain the Owner Representative's written approval thereof before proceeding. List all materials by manufacturer's name and model number.
 3. Submit to Local Water Purveyor a copy to the Owner Certification of Installation as required by the State of California Model Water Ordinance.
 4. Use only accepted materials and items of equipment.
- B. Substitutions:
1. If the Contractor desires to substitute a product, the contractor shall list each item and note it as a "substitution" and provide the following information:
 - a. Descriptive information describing its similarities to the specified product.
 2. If the product is approved and, in the opinion of the Owner's Representative, the substituted product does not perform as well as the specified product, the Contractor shall replace it with the specified product at no additional cost to the Owner.
- C. Operations and Maintenance Manuals:
1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Operation and Maintenance Manuals to the Owner's Representative for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each manual shall contain the following:
 - a. Index sheet indicating the Contractor's name, address and phone number.
 - b. Copy of the Landscape Irrigation Audit
 - c. Copy of the 12-month irrigation schedule and estimate of annual water consumption
 - d. Copies of equipment warranties and certificates.
 - e. List of equipment with names, addresses and telephone numbers of all local manufacturer representatives.
 - f. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.
 - g. Parts list of all equipment such as controllers, valves, solenoids and heads.
- D. Record Drawings:
1. Dimension the location of the following items from two (2) permanent points of reference such as building corners, sidewalks, road intersections, etc.:
 - a. Connection to existing water lines/meter.
 - b. Connection to electrical power.
 - c. Gate valves.
 - d. Routing of sprinkler pressure lines (a dimension at least every 100 feet and as required to identify all changes in direction and location).
 - e. Remote control valves.
 - f. Routing of control valves.
 - g. Quick coupling valves.
 - h. All sleeve locations.
 - i. Routing of all control wiring.
 - j. Include all invert elevations below 12".
 2. Deliver a reproducible record drawing to the Architect within seven (7) working days before the date of final review. Delivery of the record drawings shall not relieve the Contractor of the responsibility of furnishing required information in the future.
- E. Controller Plan:

1. Provide one Irrigation Diagram plan in each controller housing. The plan shall show the area controlled by each valve in different colors and for orientation, any major permanent structure such as buildings and roads.
 2. Charts to be waterproof and hermetically sealed between two pieces of transparent 10 mil thick plastic and installed in each controller on the door as accepted by the Owner's Representative no later than the time of the coverage test of the irrigation system.
- F. Maintenance Material - supply the following tools to the Owner:
1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of sprinkler, valve or other equipment supplied on this project.
 2. Two (2) keys for each type of equipment enclosure.
 3. Two (2) keys for each type of automatic controller.
 4. Two (2) keys for each type of valve (including square type key for valves larger than 2")
 5. Two (2) quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
 6. All lock keys shall be keyed alike.
- G. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 3. Validation: Provide validation for the LFM's.
 - a. Recycled Content.
 - b. Regional Materials.
 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish and deliver materials in manufacturer's packaging, bearing original legible labeling.
- B. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of the pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented, cracked, or otherwise damaged shall be discarded and, if installed, shall be replaced with new piping.

1.6 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install main line trenching prior to acceptance by Owner's Representative of rough grades completed under another Section.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of events:
 1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving and through walls prior to placement of those materials.
 2. Bubbler Heads: Install after placement of tree, but prior to backfill with planter soil mix.
 3. Coordinate work schedule with Owner's Representative to avoid disruption of landscape maintenance of existing landscaping.
 4. Install piping prior to soil preparation (planting soil amendment installation).

1.7 WARRANTY, per Section 01 7800.

- A. In addition to manufacturer's guarantees and warranties, work shall be warranted for one (1) year from date of final acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the Owner's Representative.
- B. Include a copy of the warranty form in the Operation and Maintenance Manual.

1.8 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 PIPE

- A. Pressure Main Line Pipe and Fittings: All PVC fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
- B. All main line pipes 11" and larger shall be gasket/bell and shall be class 235 unless shown otherwise on the Drawings.
- C. Where reclaimed water is to be utilized, all main line pipe 4"+ shall be gasket/bell welded and manufactured from purple-colored PVC material and shall be printed on two sides with the wording "CAUTION-RECLAIMED WATER" every 24 inches along pipe.
 - 1. PVC Pressure Rated Pipe: ASTM D2241 NSF approved Type I, Grade I, solvent welded PVC with an appropriate standard dimension ratio (S.D.R.).
 - 2. PVC Scheduled Pipe: ASTM D1785 NSF approved, Type I,
 - 3. Grade I, solvent welded PVC.
 - 4. PVC Solvent-weld Fittings: ASTM D2466 Schedule 80, 1-2, II-I NSF approved.
 - 5. Solvent Cement and Primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
 - 6. Connections between Main Lines and RCVs: Schedule 80 PVC (threaded both ends) nipples and fittings unless required otherwise by local jurisdiction.
 - 7. Valves 3" and larger shall be flanged only.
 - 8. Copper pipe shall be Type K or Red Brass where threaded joints are required and Type L otherwise.
- D. All lateral line pipe <4" shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.
- E. All lateral line pipe shall be solvent welded Schedule 40 manufactured from purple-colored PVC material and shall be printed on two sides with the wording "CAUTION-RECLAIMED WATER" every 24 inches along pipe.

2.2 CONDUITS & SLEEVES

- A. Sleeving shall be Schedule 40 PVC pipe sleeves and a minimum of two times the aggregate diameter of all pipes contained within the sleeve. Provide vertical sweep for all electrical conduit on each side of hardscape and terminate ends at 12" minimum depth and 12" from hardscape surface.

2.3 BACKFLOW PREVENTION DEVICE

- A. As required by Code and as shown on Drawings. Verify with Owner's Representative if Anti-freeze Jacket is required and provide as required.
- B. Riser assemblies from main line burial depth to backflow preventers shall be Schedule 40 brass pipe.
- C. All metallic pipe and fittings installed below grade shall be painted with two coats of Koppers #50 Bitumastic, or approved equal. Pipes may be wrapped with an approved asphaltic tape in lieu of the liquid-applied coating.

2.4 BACKFLOW PREVENTION DEVICE ENCLOSURE

- A. "Smooth Touch" enclosure without sharp edges, 100% stainless steel by Strong Box, available from V.I.T., Escondido, CA (800) 729-1314 or equal. Coordinate size of enclosure with plumbing for minimum clearance and size. Enclosure to include concrete footing with hasp and staple to receive padlock. Padlock N.I.C.

2.5 CENTRAL CONTROL SYSTEMS

- A. Work includes a complete and efficient sprinkler irrigation control system intended to control an expansive irrigation system including, but not limited to: central irrigation software and hardware, satellite field controllers, flow meters, master valves, and wiring.
- B. Hardware and Computer Package, Laguna Software (minimum requirements):
 - 1. Computer & Monitor
 - 2. Ethernet drop or other internet connection
 - 3. Uninterruptible power supply
 - 4. Controller manufacturer's software
- C. Satellite Irrigation Controllers:
 - 1. Capable of operating with manufacturer's Central Control System software.

2.6 CONTROLLERS:

- A. Wall-mounted or pedestal-mounted irrigation controller, most current DX controller series and with the following minimum requirements as shown on drawings.
- B. Shall be weather – based and be compatible with rain shut off sensor.
- C. Shall be user-friendly. The controller must have a minimum 20-character readout display describing actions or options, or a full visible panel of buttons, dials, or switches that control all different functions separately.
- D. Shall have the ability to start a programmed sequence of valves a minimum of 5 times a day per program.

- E. Shall have ability to easily and quickly change watering schedules due to change in weather.
- F. Provide portable hand-held remote device compatible with controller and capable of operating all control valves.
- G. Provide rain shut off device as manufactured by Control System manufacturer capable of shutting off all control valves. Locate in a location exposed to rain and hardwire to controller.

2.7 CONTROLLER GROUND

- A. Provide each pedestal controller with its own ground rod. Separate the ground rods by a minimum of eight feet. The ground rod shall be an eight foot long by 5/8" diameter U.L. approved copper clad rod or as recommended by controller manufacturer. Install no more than 6" of the ground rod above finish grade. Connect #8 gauge wire with a U.L. approved ground rod clamp to rod and back to ground screw at base of controller with appropriate connector. Make this wire as short as possible, avoiding any kinks or bending. Install within pedestal housing base unless otherwise noted.
- B. Provide each irrigation controller with its own independent low voltage common ground wire.

2.8 CONTROLLER ENCLOSURES

- A. Use one of the following (unless noted otherwise on the Drawings). Verify correct equipment to fit the specified equipment:
 - 1. Stainless steel, NEMA Type 3 rated, with back panel, padlocking hasp and padlock Rain Bird, Le Meur, "Strong Box" or approved equal. See drawing for pedestal construction.
 - 2. Rain Bird, "Non-Central" Controller Assemblies
 - a. LXMM – ESP – LXM Cabinet, Powder Coated Steel
 - b. LXMPED – ESP-LXM Pedestal, Powder Coated Steel
 - 3. from Rain Bird Services Corporations "Package Systems" for "Central Control" projects. Available from Rain Bird Services Corporation (RBSC) (888) 444-5756.
 - 4. Le Meur, (714) 822-5100.
 - 5. "Strong Box" available from John Deere, (800) 347-4272.

2.9 MASTER CONTROL VALVE

- A. Master control valve shall be a 24 VAC, industrial type, solenoid control valve, Griswold 2000 series or equal. Valve shall be equipped with spring loaded packless diaphragm, cast iron body and bronze trim. The valve type to be normally open or normally closed as required by controller manufacturer and shall be equipped with four-prong (cross) flow control. Valve shall be slow closing without chatter settings or adjustment. Valve shall have a mechanical self-purging internal control system with tapered, serrated, scrubbing rod through diaphragm for positive, variable port opening and cleaning. No solenoid port screens. Valve solenoid shall be corrosion-proof, molded in epoxy to form one integral unit with no connection shunts and shall be 24 VAC, 3 watt maximum.

2.10 FLOW SENSORS

- A. Compatible with controller and as recommended by controller manufacturer and as shown on drawings.

2.11 ISOLATION VALVE:

- A. Valves 3 inches and smaller: 125 lb. WSP bronze gate valve with screw-in bonnet, non-rising stem and solid wedge disc, NIBCO T-113 K, or approved equal. Valves shall be line size.

- B. Valves larger than 4": shall have square nut stem and o-ring connections for key operation.

2.12 QUICK COUPLER VALVES:

- A. Quick coupler valves shall be as listed on the Drawings with 10" diameter brass box and one-piece lid similar to isolation valve box described below.
- B. Where reclaimed water is to be utilized, quick coupler valves shall be equipped with purple covers. Box shall have purple color lid (unless noted otherwise), with marked "Irrigation-Reclaimed Water" and with bilingual non-potable warning and symbol.

2.13 BOX FOR ISOLATION & VALVE & QUICK COUPLER VALVES

- A. 10" diameter plastic, Ametek, Brooks, Christy, Rain Bird with bolt down lid marked "irrigation," or accepted equal. Avoid locating valve in paved areas. Provide H/20 Loading concrete box with bolt-down concrete lid if valve is located in paved area. Obtain location approval by Owner's Representative.
- B. Where reclaimed water is to be utilized, isolation valves shall be equipped with purple covers. Box shall have purple color lid (unless noted otherwise), with marked "Irrigation- Reclaimed Water" and with bilingual non-potable warning and symbol.

2.14 REMOTE CONTROL VALVE:

- A. Remote control valves shall be those normally manufactured for irrigation systems and shall have a slow, consistent speed of closure through entire closing operation, including last portion. To ensure this, the effective diaphragm working area/valve seating opening ratio must be a minimum 3 to 1.
- B. Shall be mechanically self-cleaning to help prevent diaphragm or solenoid port plugging. To ensure this, the flush rod should be tapered to vary the size of the port opening as the diaphragm raises and lowers, thus allowing trapped material to escape. Rod is to be finished with a serrated surface to help scrub trapped material out. Screens not acceptable.
- C. Shall have removable valve seat so valve can be repaired without removal from irrigation line.
- D. Shall have ability to operate manually without the use of wrenches or special keys.
- E. Shall have pressure regulating type with basket filter for drip systems.
- F. Shall have one-piece solenoid that attaches directly to valve without shunts or clips that can be lost.
- G. Shall have cross top handle to adjust maximum travel of diaphragm to allow "tuning" of valve and closure.
- H. Where reclaimed water is to be utilized, remote control valve to contain non potable purple cap.

2.15 BOX FOR REMOTE CONTROL VALVE

- A. Rectangular valve box - Ametek, Carson, Christy, Rain Bird or accepted equal with non-hinged bolt down. Do not saw cut body. Use smallest box size that will fit irrigation components. Valve box lids are to indicate the controller letter and station number of valve as accepted by Owner's Representative. Also refer herein to required polyurethane tag at valve

solenoid control wire under Control Wires. Locate the identification in center of the lid. Provide separate box for each valve. Provide H/20 Loading concrete boxes with bolt-down concrete lids for all valves that occur in paved areas.

- B. Valve box should be purple for non potable water colored lid marked "irrigation" and with bilingual non-potable warning and symbol "Irrigation-Reclaimed Water" text for recycled water. Box body shall have knock outs.

2.16 CONTROL WIRES

- A. Connections between automatic controllers and the solenoid-operated electric control valves shall be made with direct burial copper wire 14- AWG-UF 600 volt (minimum size). Pilot wires shall be a color other than white, and shall be a different color for each automatic controller with wires sharing a common trench. Common wires shall be white in color, with a different color stripe for each controller with wiring sharing the same common trench. No stripe is required if multiple controller wiring is not present.
- B. Size of wire shall conform to the remote control valve manufacturer's specification for control wire sizes, but in no case shall the control wire be smaller than #14. Runs over 2,000 lineal feet shall be #12- AWG-UF 600 volt copper wire.
- C. All wire splices are to be made within a valve box, with a copper crimp-type connector, and a "3- M" #DBY splice kit or Rain Bird "DBTWC25".
- D. Use continuous control wiring between controllers and remote control valves (no splices).
- E. Provide polyurethane tag at valve solenoid control wire that shows the controller number and station number. Also refer to valve box lid identification.
- F. Provide three spare control wire in each valve bank for future, unless utilizing a two wire system.

2.17 SPRAY HEADS

- A. Pop-up as shown on drawings and with the following minimum requirements:.
- B. Shall have approximately 30 psi water pressure coming out of nozzle to prevent "fogging" or misting. Shall have pressure-compensating devices.
- C. Shall have ability to prevent low head drainage. Use heads with integral check valves.
- D. Rain Bird 1800 Spray Body with SAM -PRS Series or Hunter PRO-SPRAY series.
- E. Shall not have spray blocked by turf or shrubbery; use minimum 6" pop-ups in turf areas.
- F. Where reclaimed water is to be utilized, spray to contain purple non potable cover/cap

2.18 ROTOR HEADS

- A. As shown on drawings and with the following minimum requirements:
- B. Heads shall have exact matched precipitation rates. Radius and precipitation rates must be the same.
- C. Where reclaimed water is to be utilized, Rotor to contain purple non potable cover/cap

2.19 SWING JOINTS

- A. For sprinklers and bubblers use Dura, Lasco, Rain Bird or equal pre-assembled swing joints with O-rings.
- B. Quick Coupling Valve: Dura 1-inch 1-A2-1-11-18 pre-assembled swing joint with O-rings and Dura quick lock to receive stabilizing rod.

2.20 SHRUB & TREE BUBBLERS

- A. Rainbird Toro or Equal, connect bubbler to swing joint with flexible tubing by Salco or equal.

2.21 DRIP EMMITTER IRRIGATION

- A. Drip Manifold:
 - 1. Pressure Regulator: Preset at 30 psi outlet pressure, $\frac{3}{4}$ " female threaded inlet and outlet, by RainBird, Torro or equal.
 - 2. Emitters: Xeri-Bug (XB Series) by RainBird, Toro EZ Drip Series, or equal.
 - 3. Flexible PVC: ASTM D2287 algae-resistant flexible PVC as recommended by manufacturer of Drip Emitters.
 - 4. Drip tubing: Conform to A. S. A. E. standards for minimum inside diameter and wall thickness, Minimum 2% carbon black, Salco $\frac{3}{4}$ " AR Drip PVC flexible drip hose, or equal.
 - 5. $\frac{3}{4}$ " Y-filter, 200 mesh.
 - 6. Toro DL 2000 Air/Vacuum Relief Valves and In-line Spring Check Valves.
 - 7. $\frac{3}{4}$ " manual Sch. 80 PVC ball valve with extra 3' of hose coiled in valve box.
 - 8. Drip system in accordance with "RainBird Xerigation Low-Volume Landscape Irrigation Design Manual" and as shown on the drawings as required for a complete working system.
 - 9. Where reclaimed water is to be utilized, drip tubing, flush cap and diffuser cap to be non-potable purple color, or striped.

2.22 IN-LINE DRIP IRRIGATION

- A. As specified herein and as shown on the drawings and in accordance with manufacturer's recommendations. Provide all miscellaneous valves, filters fittings etc. required for a complete, operable system including the following:
 - 1. Rain Bird XFD/XFS/XFCV with "Copper Shield" technology or equal. Drip system in accordance with manufacturers recommendations and as shown on the drawings as required for a complete working system.
 - 2. Toro DL 2000 Techline, in-line Teflon impregnated emitter with Netafim Automatic Flush.
 - 3. Pop-up operation indicator, Rainbird OPERIND or equal.
 - 4. Air/vacuum relief valves
 - 5. Flush valves
- B. Drip Valve Assembly: Size valve box large enough and deep enough to contain assembly and allow convenient access and easy removal of filter screen.
- C. Pressure regulator: Size regulator in accordance with flow rate. Do not over size. Use factory pre-set regulator at 30 PSI.
- D. Where reclaimed water is to be utilized, subsurface dripline tubing flush cap, and diffuser cap to be non-potable purple color.

2.23 Y-STRAINER/BASKET FILTER (FOR DRIP SYSTEMS)

- A. "Y"-Strainer and/or Basket Filter upstream of remote control valves, Brass, 100 mesh.

2.24 RCV IDENTIFICATION TAGS:

- A. Plastic or brass tags with valve number, approximately 2" by 2" with number imprinted, as accepted by Owner's Representative.

2.25 MISCELLANEOUS INSTALLATION MATERIALS

- A. Solvent Cement and Primers for Solvent-weld Joints: Make and type approved by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.
- B. Pipe and Joint Compound: Permatex or equal: Do not use on sprinkler inlet port.

2.26 MISCELLANEOUS EQUIPMENT/ACCESSORIES

- A. Concrete for equipment pads (and thrust blocks if Bell-Type Pipe with O-Rings is required): Poured-in-place Class A concrete per Section 90 of the Caltrans Standard Specifications.
- B. Key(s) for Irrigation Equipment from Manufacturer.
- C. Other equipment as shown on Drawings and required for a fully functional irrigation system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.
- B. Water Meter/Water Pressure: Test and verify that existing water pressure is the minimum pressure at maximum system g.p.m. to operate the irrigation system as indicated on the drawings.
- C. Stub-outs: Verify that all stub-outs to be provided under another contract are correctly sized, located and installed as noted on Drawings.
- D. Notification: Submit written notification to Owner's Representative within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.2 CONNECTIONS TO SERVICES

- A. Provide and coordinate connection to water meter and/or water supply.
- B. Provide and coordinate connection of irrigation controller to electrical power source.

3.3 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. The irrigation drawings may not show all and below grade structures and utilities that are known to the Owner's Representative. Review all drawings to locate known above and below grade structures and utilities. Locate known existing installations before proceeding with construction operations that may cause damage to such installations. Existing installations

shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum. Verify with Owner's Representative if As Built drawings are available.

- B. If other structures or utilities are encountered, request Owner's Representative to provide direction on how to proceed with the Work. If a structure or utility is damaged, take appropriate action to ensure the safety of persons and property.
- C. Verify location of existing irrigation systems to be removed and/or replaced. Maintain any existing systems as required by the Drawings and Specifications, including temporary retention of systems necessary to maintain existing on site and adjacent planting.

3.4 INSTALLATION

- A. Install irrigation system components in accordance with this Section, with the Drawings, with the manufacturer's recommendations, and with established industry standards. The Contractor shall do nothing that may jeopardize any manufacturer warranty.
- B. Automatic Controller:
 - 1. General: Install with lock box cutoff switch per local code and manufacturer's current printed specifications. Provide each controller with its own independent low voltage common ground wire.
 - 2. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 - 3. Labeling: Affix controller letter (i.e., "A") on inside of controller cabinet door with minimum of one-inch (1") high permanent letter.
 - 4. Irrigation Diagram: Affix a non-fading, waterproof copy of irrigation diagram to cabinet door below controller name.
- C. Control Wiring:
 - 1. General: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
 - 2. Extra Length: Provide 30 inches (30") extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
 - 3. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than #14.
 - 4. Detection Wire: Install a bare #12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search. Install the control wires on the bottom of the PVC supply line with electrical tape every ten feet (10').
 - 5. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 feet and only in junction boxes.
- D. Rain Shutoff Switch:
 - 1. Install switch in area not affected by irrigation overhead coverage or rain shadow. Provide wires in rigid conduit as accepted by Owner's Representative.
- E. Excavating and Trenching:
 - 1. Prior to trenching, layout main and lateral line locations within Drip Line of trees and review locations with Owner's Representative. Relocate any lines that may interfere with existing root systems to avoid or reduce damage to root systems as accepted by Owner's Representative.

2. Dig trenches wide enough to allow a minimum of three inches (3") between parallel pipe lines. Provide a minimum cover from finish grade as follows:
 3. Mechanical Trenching is not allowed within dripline of existing trees to be protected except as approved by Owner's Representative.
- F. Conduits and Sleeves:
1. Coordination: Provide conduits and sleeves and coordinate installation with other trades.
 2. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls as shown on Drawings. Extend twelve inches (12") beyond edges of paving and walls and cap ends until ready for use.
- G. Pipeline Assembly:
1. Install pipe and fittings in accordance with manufacturer's current printed Specifications.
 2. Clean all pipes and fittings of dirt, scale and moisture before assembly.
 3. Solvent-welded Joints for PVC Pipes:
 - a. Solvents: Use solvents and methods specified by pipe manufacturer.
 - b. Curing Period: Minimum of one (1) hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.
 4. Threaded Joints for Plastic Pipes:
 - a. Use Permatex on all threaded PVC fittings except sprinkler heads and quick coupler valve ACME threads.
 - b. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench. Assemble finger tight plus one or two turns.
 5. Laying of Pipe:
 - a. Bedding On-grade: Remove from trench all rocks or clods. Bed pipe in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
 - b. Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional foot per 100 ft. of pipe.
 - c. Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is dry.
- H. Closing of Pipe and Flushing of Lines:
1. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
- I. Detection Wire and Warning Tape:
1. Install a bare #12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search.
- J. Control Valves:
1. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level. If valve occurs in drainage swale, relocate out of drainage swale as approved by Owner's Representative.
 2. Where two or more valves are installed adjacent to each other, provide at least six inches (6") separation. Align boxes in a row, perpendicular with pavement edge.
 3. Permanently mark valve box lid with 2" black valve number and controller letter or with numbered metal tag inside box as approved by Owner's Representative.
 4. Refer to control wiring for required spare wire in each valve box.
- K. Install "Y"-Strainer at remote control valves as recommended by manufacturer of valve.
- L. RCV Identification Tags:

1. Install in remote control valve box as recommended by manufacturer and as accepted by Owner's Representative.
- M. Pop-up Spray Heads and Rotors:
1. Place all sprinkler heads in planting areas with top of heads set to finish grade or top of mulch as required.
 2. Place part-circle pop-up sprinkler heads two inches (2") from edge of and flush with top of adjacent walks, header boards, curbs and mowing bands or paved areas and 12 inches (12") from building foundations at time of installation.
 3. Set all sprinkler heads in turf to allow for settlement. Adjust as required after settlement. Hold heads two inches (2") clear of pavement edge.
- N. Bubblers:
1. Coordinate installation with planting contractor to ensure timely and proper placement of heads at new planting.
- O. In-Line Drip Irrigation
1. Coordinate plant locations with emitter locations. Refer to QUALITY ASSURANCE herein.
 2. Coordinate hand watering of emitter irrigated and drip irrigated areas. Refer to QUALITY ASSURANCE herein.
 3. Coordinate emitter spacing with planting types and plant spacing as accepted by Owner's Representative. Install emitters at uniform on center maximum and 2 to 4 inches deep, except where emitter spacing and depth is shown otherwise.
 4. In Turf in raised (podium) planters and similar sandy soil planting areas, install emitters at uniform 12 inches on center maximum and 3 inches deep, except where emitter spacing and depth is shown otherwise.
 5. Adjust spacing on slopes to prevent over watering at base of slopes. Install system in accordance with manufacturer's recommendations and as shown on the Drawings as required for a complete working system.
 6. Provide air/vacuum relief valves at all high points on systems.
 7. Provide filter as shown and as recommended by emitter manufacturer.
 8. Tape pipe ends during installation and do not allow dirt or debris to enter pipe.
 9. Use emitter line with the specified emitter flow rate and emitter spacing. Assemble dripper line to allow water to flow continuously and directly, with no dead ends or dead end loops between control valve and flush valve.
 10. Use fittings at sharp bends and do not allow dripper line to kink.
 11. Install emitter line around perimeter of planter not more than 3 inches off edge for ground cover and turf, 18 inches maximum for shrub planting.
 12. Adjust alternate rows so emitters are spaced in a triangular pattern.
 13. Collect water from multiple dripper lines and convey the water to automatic line flush valve.
 14. Install flush valve at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.
 15. Flush valves shall be open when water is turned on for the first time and after a break in the main or lateral lines. Extend collector lateral as required and locate flush valve at convenient accessible location.
 16. Flush the systems weekly through the first month of the maintenance period.
 17. Thoroughly saturate soil prior to planting. Provide additional surface watering as required to keep plant root systems moist during planting establishment period.
 18. Install operation indicator as shown on drawings or where approved by Owner's Representative.
- P. Drip Emitter Irrigation:

1. Install system in accordance with "RainBird Landscape Irrigation Design and Specifications Xerigation Products and Details" or equal and as shown on the Drawings as required for a complete working system.
2. Install Toro DL 2000 Air/Vacuum Relief Valves at high points in system.
3. Install manual PVC ball valve with extra 3' of hose coiled in valve box at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.
4. Install a continuous PVC irrigation mainline warning tape 12" above the supply line.
5. Install operation indicator as shown on drawings or where approved by Owner's Representative.

3.5 MISCELLANEOUS EQUIPMENT

- A. Install miscellaneous equipment with concrete footings, brackets, etc., as required and as recommended by manufacturer.

3.6 FIELD QUALITY CONTROL

- A. Testing of Irrigation System:
 1. Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure.
 2. Keep all couplings and fittings exposed.
 3. Install two (2) pressure gauges at opposite ends of main line system. Pump system up to a minimum of 125 psi the day preceding the scheduled test and verify that pressure is holding. Inspect system early following day and immediately notify Owner's Representative if the test confirmation must be postponed.
 4. Apply continuous static water pressure of 125 psi in accordance with Caltrans Standard Specifications Section 20-5.03H, except after a drop in pressure (5 psi maximum), then the pressure must stabilize and remain stable for a one (1) hour minimum period before acceptance of the test.
 5. Leaks detected during tests shall be repaired and test repeated until system passes tests at no additional cost to Owner.
- B. Irrigation Audit Report with Certificate of Completion
 1. Per the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall perform an irrigation audit and provide a report with certificate of completion to the local agency that may include, but is not limited to: inspection, system tune-up, system test with distribution uniformity, reporting overspray or run off that causes overland flow, and preparation of an irrigation schedule. Irrigation audits shall be conducted by a CLIA Certified landscape Irrigation Auditor by the Irrigation Association. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.
- C. Adjustment of the System:
 1. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways and buildings. Adjust the arc and radius as applicable.
 2. Include as a part of the work any nozzle changes or arc adjustments necessary due to daytime windy conditions during grass establishment period. After grass has been established and watering can be performed during calm early morning or evening hours, make any required adjustments to nozzles and arcs.
 3. Set all sprinkler heads perpendicular to finished grades unless otherwise noted on the drawings.
 4. When the landscape sprinkler system is completed and before planting, perform a coverage test in the presence of the Owner's Representative to determine if the water coverage for planting areas is adequate.

5. Test controllers individually in the presence of the Owner's Representative and the Landscape Architect. Demonstrate that all control valves operate electronically. Provide vehicles and radio equipment as necessary to expedite this process.
6. Demonstrate to Owner's Representative that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.7 OPERATION

- A. Routine: Inspect and adjust all spray heads and control valves including raising or lowering of spray head heights to accommodate plant growth and weather conditions.
- B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth and weather conditions.
- C. System Failure: Perform all repairs within one (1) operating period. Replacements to match removed products and materials in all respects. Report promptly all damage not resulting from Contractor's operations. Repair all damage caused by Contractor at no expense to Owner.
- D. Climate Change: Set and program automatic controllers in response to seasonal requirements and requirements of newly planted materials.

3.8 IRRIGATION SCHEDULING AND CONTROLLER PROGRAMMING

- A. Per the requirements of the California Model Water Efficient Landscape Ordinance All irrigation schedules and programs shall be developed, managed and evaluated to utilize the minimum amount of water required to maintain plant health.
- B. Irrigation controller Scheduling and Programming Parameters to be conducted by a CLCA Certified Irrigation manager and submitted to the local agency as part of the Certificate of Completion.
- C. Parameters used to set the automatic controller shall be developed for each of the following:
 1. Plant establishment period
 2. Established landscape period
 3. Temporary irrigated area (if applicable)
- D. Each irrigation schedule shall consider for each station all of the following that apply:
 1. Irrigation interval (days between irrigation)
 2. Irrigation run times (hours or minutes per irrigation event to avoid runoff)
 3. Number of cycle starts required for each irrigation event to avoid runoff
 4. Amount of applied water scheduled to be applied on a monthly basis
 5. Application rate setting
 6. Root depth setting
 7. Plant type setting
 8. Soil type
 9. Slope factor setting
 10. Shade factor setting
 11. Irrigation uniformity or efficiency setting
- E. Total annual applied water shall be less than or equal to Maximum Applied Water Allowance (MAWA). Actual irrigation schedules shall be regulated by automatic irrigation controllers using current reference evapotranspiration data (CIMIS or soil moisture sensor data).

3.9 BACKFILL AND COMPACTING

- A. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.
- B. Backfill for All Trenches: Regardless of the type of pipe covered, compact to minimum 95% density under pavements and 85% under planted areas.
- C. Finishing: Dress off areas to finish grades. Re-dress any areas which subsequently settle.
- D. Owner's testing agency will test backfill compaction in areas under paving.

3.10 MAINTENANCE

- A. The entire sprinkler irrigation system shall be under full automatic operation for a period of 2 days prior to any planting.
- B. The Owner's Representative reserves the right to waive or shorten the operation period.
- C. Maintain/repair system for full duration of plant maintenance period.

3.11 REVIEWS PRIOR TO ACCEPTANCE

- A. Notify the Owner's Representative in advance for the following reviews, according to the time indicated:
 - 1. Supply line pressure test and control wire installation - 72 hours.
 - 2. Coverage and controller test - 72 hours.
 - 3. Final review - 7 days.
- B. No reviews will commence without record drawings, without completing previously noted corrections, or without preparing the system for review.

3.12 FINAL REVIEW AND CLEANUP, per Section 01 7000.

- A. Operate each system in its entirety for the Owner's Representative at time of final review. Any items deemed not acceptable by the Owner's Representative shall be reworked to the complete satisfaction of the Owner's Representative.
- B. Provide evidence to the Owner's Representative that the Owner has received all accessories and equipment as required before final review can occur.
- C. Final acceptance and start of warranty period will occur no earlier than the end of the plant maintenance period.
- D. Contractor shall arrange a meeting with the Owner's maintenance personnel to demonstrate the operation of the irrigation systems automatically in order to verify acceptance and to familiarize the maintenance personnel with the system and recommended programming with the goal of maintaining healthy, thriving plants.

END OF SECTION

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SECTION 32 3300

SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. All site and street furniture, equipment and accessories indicated on the drawings and/or herein specified, including all footings, anchorages, frames and accessories required to provide complete, safe and usable furnishings to the satisfaction of the Architect.
 - 2. Shop prime coat, painting and galvanized finishes for all metal and wood not having factory finishes.

1.3 RELATED WORK:

- A. Section 32 1313 – SITE CONCRETE
- B. Section 05 5000 – METAL FABRICATIONS
- C. Section 06 2013 – SITE CARPENTRY

1.4 REFERENCES AND STANDARDS

- A. Section 05 5000 – METAL FABRICATIONS
- B. American Society for Testing and Materials, (ASTM).
- C. Manufacturer's printed specifications, instructions and shop details for installation of the indicated and /or specified site and street furnishings.
- D. Standard Specifications: where referred to in these specifications, "State Specifications" shall mean the California CalTrans Specifications, latest edition.

1.5 QUALITY ASSURANCE

- A. Site and Street Furnishings work shall comply with these specifications and all applicable sections of the above-named References and Standards.

1.6 SUBMITTALS

- A. Submit manufacturer's product data, specifications, and installation instructions and shop details for factory fabricated items.
 - 1. Trash / Recycling Receptacles
 - 2. Bike Racks
 - 3. Bollards

- B. Submit shop drawings. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
- C. Submit samples of selected colors and finishes.
- D. Sustainable Design: Information necessary to establish and document compliance with the USGBC LEED Silver Certification for this Project.
 - 1. A completed LEED Reporting Form (LRF) with a separate line item completed for each LEED Focus Materials (LFM).
 - 2. Product cut sheets for each LFM confirming that the submitted products are the products installed as part of the Work.
 - 3. Validation: Provide validation for the LFM's.
 - a. Recycled Content.
 - b. Regional Materials.
 - 4. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and recycled products.
 - b. Certify source for regional materials and distance from Project site.
 - 5. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle furnishings to prevent damage and deterioration.
- B. Stack assembled items off the ground.

1.8 PROJECT CONDITIONS

- A. Coordinate work with trades furnishing adjacent work related to site and street furnishings installation.
- B. Provide sleeves, anchors, inserts, bolts, clips, and other items furnished under this Section and built in with work of other trades.
- C. No work shall be installed until shop drawings for the work have been reviewed and approved in writing by the Architect, and final grading and surfacing is completed.

1.9 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with General Contractor's Demolition and Waste Management Plan.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the General contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to the drawings for Manufacturers and Site and Street Furnishings model numbers.
- B. Concrete: ASTM C94 ready mixed concrete, minimum 28-day compressive strength of 2,500 psi, air-entrained 2% to 4%.

- C. Sleeves for embedded items: Schedule 40 galvanized steel pipe.
- D. Grout: CE CRD C588, non-shrink, non-ferrous type; Master Builder's "EMBECO" or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate under which site and street furnishings are to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide footings, sleeves, frames and anchorages. Furnish templates, setting drawings, and instructions for installation of sleeves and anchorages built into other work.
- B. Locate and layout all furniture, accessories and equipment items. Obtain the Architect's written approval of the layout prior to installation.

3.3 INSTALLATION

- A. Assemble and install site and street furnishings in accordance with approved shop drawings and manufacturer's printed instructions.
- B. Perform fitting required for installation. Set the work accurately in location, alignment, and elevation free of rack, measured from established lines and levels. Assembled furnishings shall be firm, rigid, free of rattle, and provide maximum protection against tampering and vandalism.
- C. Minimum concrete footings for embedded metal bench and litter unit posts: 18" diameter x 2'-6" deep.
 - 1. Where footing is in paving, the paving shall cover the footing.
 - 2. Where the footing is free standing, neatly form with sono-tubing and taper 1/4" away from post.
- D. Litter receptacles: install a plastic liner in each unit; turn over the balance of the specified liners to the Owner.

3.4 CLEANING

- A. Perform cleaning during installation and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent work resulting from site and street furnishings work.
- B. Upon completion of installation, clean factory-finished items in accordance with manufacturer's cleaning instructions. Exercise care to avoid damage to the finish coating.

END OF SECTION

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SECTION 32 9110

TOPSOIL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Scarification of Subgrade
 - 2. Installation of topsoil from site stockpiles
 - 3. Installation of clean topsoil or import topsoil next to the building or paving that has been treated with lime required to complete the work.
- B. Related Sections include the following:
 - 1. Section 31 2000, EARTHWORK AND GRADING
 - 2. Section 32 9300, PLANTING

1.3 REFERENCES

- A. USDA Handbook No. 60

1.4 DEFINITIONS

- A. Existing Soil: Area of undisturbed native soil where no rough grading is to be performed. Surface cultivation and soil amending are included in this Section. See Drawings.
- B. Subgrade: Soil level resulting from the rough grading work under another Section. Cultivation of all subgrade areas prior to placement of topsoil is included in this Section.
- C. Topsoil: Soil stockpiled for spreading over prepared subgrade.
 - 1. Stockpiled Native Topsoil: Topsoil stripped from the site prior to rough grading work under another Section, to be spread and amended as work under this Section.
 - 2. Imported Topsoil: Off-site topsoil imported and stockpiled under this Section, to be spread and amended as work under this Section.

1.5 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. All tests will be paid for by the Owner, but the cost of retesting of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.

1.6 SUBMITTALS

- A. Soil analysis report through Soil and Plant Laboratory, Inc., 352 Matthew Street (PO Box 153),

Santa Clara, CA 95052, Tel. (408)727-0330 or approved equal. Analyses are to be obtained at Contractor's cost and are to include:

1. Existing soil: Test for agricultural suitability, parasitic nematodes and herbicide contamination. Report to include amendment recommendations.
 - a. Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Topsoil shall be amended per soils analysis report.
 2. Stockpiled Native Topsoil: Test for agricultural suitability, parasitic nematodes and herbicide contamination. Report to include amendment recommendations.
 - a. Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Topsoil shall be amended per soils analysis report.
- B. Source of supply of proposed import topsoil.
- C. Three copies of laboratory tests on the proposed import topsoil.
1. Fertility determined by pH, salinity, nitrate, ammonium, phosphate, potassium, calcium and magnesium analysis.
 2. Agricultural Suitability as determined by pH, salinity, boron, sodium, potassium, calcium and magnesium analyses using USDA saturation extract procedure.
 3. Appraisal of the soil type and certain chemical properties provided as pH, salinity, organic matter and particle size distribution (USDA classification).
- D. Fertilizers and amendments as required through the Soil analysis report and per Section 32 9300 PLANTING.

1.7 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval of the proposed topsoil by the Architect

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Stockpiled Native Topsoil:
 1. Quantity: The approximate quantity of stockpiled native topsoil will not be known until the demolition and rough grading have been completed under Civil work.
 2. Stockpiling: Stripped topsoil shall have been stockpiled on the site under Civil work.

2.2 EXCESS TOPSOIL

- A. If more topsoil has been stockpiled on the site than is required to complete the work as indicated on the Drawings, dispose of the excess topsoil on the site at the direction of the Owner at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.3 SUBGRADE PREPARATION

- A. Grades:
 - 1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 - 2. Verify that subgrades are within 1" plus or minus, of required subgrades.
- B. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- C. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.
- D. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- E. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- F. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 - 1. All areas to be topsoiled: 8 inches deep.

3.4 INSTALLATION OF TOPSOIL

- A. Do not install topsoil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

- C. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.
- D. Remove all lime treated soil in all plant areas next to the newly constructed building and paving to a depth of three feet and dispose of off the site.
- E. Fertilize and amend the soil as required by the Soil Analysis Report. If such a report is not available at the time of bidding, the following materials shall be used for bidding purposes only:
 - 1. Soil Amendments per 1,000 square feet: Incorporate thoroughly with top six (6) inches of all planting areas:
 - a. 6 cubic yards organic amendment as specified
- F. Thickness of topsoil, including soil conditioners to be added later under Section 32 9300, shall be 6 inches and grades shall conform to those indicated on the site grading plans and specified herein.
- G. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regarded until the grade of all planting areas conforms with finished grade indicated on the Site Grading Plans to within plus or minus 1".

END OF SECTION

SECTION 32 9120

IMPORT TOPSOIL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Scarification of subgrade
 2. Installation of import topsoil
 3. Installation of import vegetable mix in raised planters
 4. Installation of import topsoil next to building that has been treated with lime

1.3 RELATED WORK

- A. Section 31 2000, EARTHWORK AND GRADING
- B. Section 32 9300, PLANTING

1.4 REFERENCES

- A. USDA Handbook No. 60

1.5 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. All tests will be paid for by the Owner, but the cost of re-testing of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.

1.6 SUBMITTALS

- A. Source of supply of proposed import topsoil types.
- B. Three copies of laboratory tests on the proposed import topsoil and vegetable mix. Fertility determined by pH, salinity, nitrate, ammonium, phosphate, potassium, calcium and magnesium analysis.
 1. Agricultural Suitability as determined by pH, salinity, boron, sodium, potassium, calcium and magnesium analyses using USDA saturation extract procedure.
 2. Appraisal of the soil type and certain chemical properties provided as pH, salinity, organic matter and particle size distribution (USDA classification).

1.7 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval of the proposed topsoil by the Architect.

PART 2 - PRODUCTS

2.1 IMPORT TOPSOIL

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Preselected Topsoil: Sandy Loam, TMT Enterprises, 408.432.9040 or equal.
- C. Agricultural Suitability:

Salinity (ECe x 10(3)):	0-2
Sodium (SAR) 2:	0-8
(ESP) 1:	0-10
Boron (PPM in Saturated Extract):	0- 0.7
pH:	5.5 to 7.5
- D. Soil Type: agricultural sandy loam; maximum 50% clay and silt fines. Meet USDA specifications for the specified texture.
- E. Quality: free of debris, rocks over 2" diameter, noxious weeds and parasitic nematodes.
- F. Should the samples not meet all of the standards given above, the soil laboratory may submit in the report what additives (in addition to those specified in Section 32 9300) should be added to the soil to correct deficiencies.

2.2 IMPORT TOPSOIL FOR RAISED PLANTER BEDS

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Preselected Topsoil: Local Hero Veggie Mix from American Soil & Stone (510.292.3000) or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.3 SUBGRADE PREPARATION

- A. Grades:
 - 1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 - 2. Verify that subgrades are within 1" plus or minus, of required subgrades.
 - 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.
- C. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- E. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 - 1. All areas to be topsoiled: 8 inches deep.

3.4 INSTALLATION OF TOPSOIL

- A. Do not install topsoil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- C. Remove all lime treated soil in all plant areas next to the newly constructed building to a depth of three feet and dispose of off the site.
- D. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.

- E. Thickness of topsoil, including soil conditioners to be added later under other Sections, shall be 6 inches and grades shall conform to those indicated on the site grading plans and specified herein.
- F. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regarded until the grade of all planting areas conforms to finished grade indicated on the Site Grading Plans to within plus or minus 1".

END OF SECTION

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SECTION 32 9300

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide planting work and planting maintenance complete as shown on the drawings and as specified including staking and layout of the landscaping, including soil sampling as required by the State of California Model Water Ordinance.
- B. Related work specified elsewhere includes:
 - 1. Section 31 1000, SITE PREPARATION AND DEMOLITION
 - 2. Section 31 2000, EARTHWORK AND GRADING
 - 3. Section 32 8100, IRRIGATION

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. All local, municipal and state laws, codes and regulations relating to all portions of this work are to be incorporated as part of these Specifications. These specifications shall not be construed to conflict with any of the above codes, regulations or requirements. The Specifications and Drawings shall take precedence when they call for materials, workmanship or construction of a better quality or higher standard than required by the above mentioned codes and regulations. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
 - 2. State of California Model Water Ordinance
 - 3. Public utility agency having jurisdiction over the project work.
 - 4. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
 - 5. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005.
 - 6. International Society of Arboriculture, Guide for Plant Appraisal, latest version.
 - 7. US Composting Council Compost Analysis Program (CAP)
 - 8. US Composting Council (USCC) Seal of Testing Assurance (STA) program.
 - 9. Test Methods for the Evaluation of Composting and Compost (TMECC)
 - 10. ASTM International: D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 11. Manufacturer's recommendations.
- B. Qualifications:
 - 1. Experience: Assign a full-time employee to the job as foreman for the duration of the Contract who is certified landscape technician, certification through CLCA or minimum of four (4) years experience in landscape installation and maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification
 - 2. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work necessary to complete the tasks described herein in a competent, efficient manner acceptable to the Owner.
- C. Requirement

1. Site Visit: At beginning of work, visit and walk the site with the Owner's Representative to clarify scope of work and understand existing project/site conditions.
 2. Supervision: The foreman shall directly supervise the work force at all times and be present during the entire installation. Notify Owner's Representative of all changes in supervision.
 3. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and a labor force uniformly dressed in a manner satisfactory to Owner's Representative.
 4. Protect all existing and new plants from construction activities, deer & rodents: Contractor shall be responsible for protection of all planting per Part 3.
- D. Plant Material Standards:
1. Quality and Size of Plants: Conform to the State of California Grading Code of Nursery Stock, No. 1 grade. Use only nursery-grown stock which is free from insect pests and diseases.
 2. Comply with federal and state laws requiring inspection for plant diseases and infestations. Submit inspection certificates required by law with each shipment of plants, and deliver certificates to the Owner. Obtain clearance from the County Agricultural Commissioner as required by law, before planting plants delivered from outside the County in which planted.
- E. Soils & Amendment Testing
1. All soils & amendments to be tested for agricultural suitability by one of the following accredited soil testing laboratories (or approved equal). The soil laboratory must be Seal of Testing Certified. Components of the test shall include all major nutrients, pH, salinity, boron, sodium, micronutrients, copper, zinc, manganese and iron, adsorption rate, organic content and texture. The laboratory report shall include recommendations for adjusting fertilizer and amendment quantities based on an organic approach.
 - a. Waypoint Analytical, Inc., 1101 South Winchester Blvd, San Jose CA 95128; (408-727-0330)
 - b. Wallace Laboratories, LLC, 365 Coral Circle, El Segundo, CA 02345, (310-615-0016)
 - c. Root Zone Associates, P.O. Box 18911, San Jose, CA 95118; (408-264-7024)
 2. Upon approval of the laboratory's report by the Owner's Representative, the recommendations in the report shall become a part of the Specifications and the soil preparation procedures, quantities of soil amendment, fertilizer and other additives shall be adjusted to conform with the report at no additional cost to the owner. Note that there is a minimum quantity of organic amendment specified elsewhere in this specification section.
 3. Significant issues with soil quality will require soil to be retested in the locations identified on Soil Analysis Plan, prior to proceeding with plant installation, to ensure that the recommendations in the report have been followed and the In-Situ Topsoil is agriculturally suitable as described in Part 2.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms. Subsoil is defined as either existing site soil located below the topsoil prior to construction activities, or select fill used for rough grading during construction. Subsoil cannot be considered for use as planting soil.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.
- D. Planting Soil: Approved existing topsoil or imported planting soil, meeting the requirements herein. Subsoil cannot be considered for use as planting soil.

1.4 SUBMITTALS, per Section 01 3300.

- A. The following shall be submitted to the Owner's Representative for approval prior to the installation of landscape materials and products. All data sheets to be included in a single submittal.
- B. Manufacturer's Technical data sheets for fertilizers, turf, and all other products and materials listed herein.
- C. Manufacturer's technical data sheets for amendments.
- D. Submit planting soil and organic amendment laboratory reports a minimum of [3] weeks prior to beginning soil prep. See below for required soil analysis reports.
- E. All reports and amendments to be submitted in a single submittal.
- F. Required Soil Analysis Reports. Reports to be dated no more than [3] months prior to soil preparation.
 - 1. Soil Analysis Plan: Contractor to submit annotated plan showing confirmed locations of all required soil tests. Each location is to be identified with a unique label.
 - 2. Existing Planting Soil Analysis: After approval of the Soil Analysis Plan, rough grading, and topsoil placement, contractor to obtain [3] representative samples of in situ topsoil taken from approved site locations at depth of 4" to 6" below finish grade and submit to an accredited soils testing laboratory for "agricultural suitability" analysis, including particle size, infiltration rate, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil.
 - 3. Subsoil Analysis: In addition to the above required soil samples, contractor to obtain one representative sample of any subgrade soil that is to receive a layer of imported planting soil over it. The laboratory report shall include the soil's infiltration rate, total combined silt and clay content for determining the total allowable combined silt and clay content of the imported planting soil specified herein.
 - 4. Imported Planting Soil Analysis: Contractor to submit an "agricultural suitability" analysis report from an accredited soils testing laboratory, including particle size, infiltration rate, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil. Soil to conform to requirements in Part 2.
 - 5. Amended Planting Soil Analysis: Significant issues with soil quality will require soil to be retested in the locations identified on Soil Analysis Plan, prior to proceeding with plant installation, to ensure that the recommendations in the report have been followed and the final Planting Soil is agriculturally suitable as described in Part 2.
- G. The Contractor is responsible to follow all local water ordinances and make available to the local agency the soil analysis report and verification of its implementation as required.
- H. Delivery Receipts upon request by Owner, provide delivery receipts for quantities of soil & amendments delivered to the site.

- I. 1-pint samples of imported soils, organic amendments/compost, mulches, and stones. All samples to be included in a single submittal.
- J. Plant sample of each variety of plant. Samples to be delivered to the site 2 weeks prior to plant installation and stored and maintained separately from entire quantity of delivered plants. Contractor to maintain plants throughout maintenance period. Plants to be reviewed in a single site visit.
- K. Representative photos of each plant species. Photos to be labelled with plants and sizes of plants to be delivered to site and not a stock photograph.
- L. Entire plant quantity delivered to the site. Plants to be reviewed prior to installation during a single site visit.
- M. Representative photos of each tree species (unless trees previously tagged at nursery by Owner's Representative). Photos to be of trees to be delivered to site and not a stock photograph.

1.5 WARRANTY AND REPLACEMENT

- A. Maintenance Period: See Part 3.
- B. Warrant the work against weed growth for a period of four (4) months after application of Pre-Emergence Weed Killer.
- C. Warrant all plants to be in a healthy, thriving condition until the end of the maintenance period, and deciduous trees, shrubs and vines beyond that time until active growth is evident.
- D. Replace all dead and damaged plants and plants not in a vigorous condition immediately upon discovery and as directed by the Owner's Representative and at no cost to the owner. Install replacement plants before the final acceptance of the maintenance period in the size specified.
- E. Warrant all products, prepared soils and plant material installed and maintained by contractor against defects for a period of one year after final acceptance of the maintenance period.

PART 2 - PRODUCTS

2.1 SUBSOIL

- A. Submit soil analysis report from an approved soils laboratory for approval by the Owner's Representative. Refer to Part 1 for soil testing requirements.

2.2 EXISTING PLANTING SOIL (ON-GRADE):

- A. Existing Planting Soil is defined as on-site topsoil that is either to be removed and stockpiled for reuse or to remain in place during construction. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 4" in diameter, and without weeds, roots, and other objectionable material. The soil shall be fertile, friable, natural, productive soil containing a normal amount of humus, and shall be capable of sustaining healthy plant life. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be obtained from well-drained, arable land, and shall be of an even texture. Soil shall not be taken from areas on which are growing any noxious weeds such as Morning Glory, Equisetum, or Bermuda Grass, etc.

- B. If herbicide contamination is suspected, then a radish/ryegrass growth trial must be performed. Consult with Owner’s Representative prior to decision to test or not.
- C. Amended Planting Soils are to conform with the following target levels. Elements are expressed as mg/kg dry soil or mg/l for saturation extract

pH value	6.5-7.9,	iron	4-15 mg/kg
lime	none present	manganese	0.6-3.0 mg/kg
salinity (ECe)	0.5-3 milli-mho/cm	zinc	1-3 mg/kg
chloride	<150 ppm	copper	0.2-3.0 mg/kg
nitrate	20-30 ppm	boron	0.2-0.5 mg/kg
SAR	<3	magnesium	25-100 mg/kg
phosphorus	8-20 mg/kg	sodium	<200 mg/kg
potassium	60-180 mg/kg	sulfur	25-100 mg/kg

- D. If sufficient on-site surface topsoil is not available, contractor to provide imported planting soil as specified below. Placement of dissimilar soils shall be coordinated with irrigation zones by the contractor to maintain separate valves for dissimilar soils.
- E. Submit soil analysis report from an approved soils laboratory for approval by the Owner’s Representative. Refer to Part 1 for soil testing requirements.

2.3 IMPORTED PLANTING SOIL (ON-GRADE):

- A. Imported planting soil shall be screened and shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances.
- B. Imported Planting Soils are to conform with the following target levels. Elements are expressed as mg/kg dry soil or mg/l for saturation extract

pH value	6.5-7.9,	iron	4-15 mg/kg
lime	none present	manganese	0.6-3.0 mg/kg
salinity (ECe)	0.5-3 milli-mho/cm	zinc	1-3 mg/kg
chloride	<150 ppm	copper	0.2-3.0 mg/kg
nitrate	20-30 ppm	boron	0.2-0.5 mg/kg
SAR	<3	magnesium	25-100 mg/kg
phosphorus	8-20 mg/kg	sodium	<200 mg/kg
potassium	60-180 mg/kg	sulfur	25-100 mg/kg

- C. The silt and clay content of Imported Planting Soil shall not exceed that of the existing soil it is to be placed over. Except where otherwise required, it shall be a "Sandy Loam" as classified in accordance with USDA Standards with a combined total of between 25% to 40% Clay and Silt.
- D. Submit soil analysis report from an approved soils laboratory for approval by the Owner’s Representative. Refer to Part 1 for soil testing requirements.
- E. Following approval of the sample, provide a one-half cubic yard sample, which shall be stored at the site of work for comparison with sample and subsequent loads of soil. The comparison sample shall be protected by a cover until the installation of all soil has been completed and accepted.

2.4 PALM TREE SOIL

- A. 100% Angular Planter Sand as specified herein.

2.5 ORGANIC AMENDMENT FOR PLANTING SOILS (ON-GRADE):

A. Ground Redwood or Ground Fir Bark with the following properties:

Percent Passing	Sieve Designation	
100	9.51 mm	3/8"
50-60	6.35 mm	1/4"
20-40	4.76 mm	No. 4
0-20	2.38 mm	No. 8 8 mesh

1. Redwood Sawdust
 - a. Dry bulk density, lbs. per cu. yd., 260-280 Nitrogen stabilized - dry weight basis, min. 0.4% Salinity (ECe): 4.0 maximum
 - b. Organic Content: 90% minimum Reaction (pH): 4.0 minimum
2. Ground Fir and/or Pine Bark
 - a. Dry bulk density, lbs. per cu. yd., Min. 350 Nitrogen stabilized - dry weight basis, min. 0.5% Salinity (ECe): 4.0 maximum
 - b. Organic Content: 90% minimum Reaction (pH): 4.0 minimum

B. Submit sample, product's technical data sheet, and analysis report from an approved soils laboratory for approval by the Owner's Representative. The analysis report should include compliance to the specifications above and directions for product use.

C. Contractor may use Composted Yard Waste Amendment in lieu of the above specified Organic Amendment pending approval of product' technical data sheet.

2.6 COMPOSTED YARD WASTE AMENDMENT FOR PLANTING SOILS (ON-GRADE):

- A. The above ORGANIC AMENDMENT FOR PLANTING SOILS (ON-GRADE) is the specified organic amendment material. Acceptance of Composted Yard Waste Amendment in lieu of the above specified amendment material will be considered if the in situ planting soil salinity and soil structure is favorable for the inclusion of recycled yard waste organic matter, as approved by the Owner's Representative.
- B. The composted yard waste amendment shall be a mixture of feedstock materials including green material consisting of chipped, shredded, or ground vegetation and mixed food waste, or clean processed recycled wood products. Single source, biosolids (sewage waste) compost will not be acceptable.
- C. The addition of the compost shall result in a final ECe of the amended soil of less than 4.0 dS/m @ 25 degrees C. as determined in a saturation extract. Use the following table to determine the maximum allowable Ece (dS/m of saturation extract) of compost at desired use rate and allowable Ece increase.

DESIRED USE RATE		MAXIMUM ALLOWABLE Ece INCREASE FROM AMENDMENT		
Cu. Yds. Amendment Per 1000 Sq. Ft. for Incorporation to 6" depth	Volume percentage of amendment	1 dS/m	2 dS/m	3 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9.5	14
4	22	3.5	7	10.5
5	27	3	5.5	8.5
6	32	2.5	4.5	7

Example: Specification calls for 6 cu. Yrds. Compost per 1000 sq. ft. for incorporation to 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding ECe of 4 in final blend, compost ECe shall be less than 4.5 dS/m.

- D. Composted Yard Waste Soil Amendment properties to conform to the following:
1. Gradation:

% Passing by weight	Sieve Designation
90	1/2"
85-100	9.51 mm 3/8"
50-80	2.38 mm No. 8
0-40	500 micron No. 35
 2. Organic Content: Minimum 50% based on dry weight and determined by ash method. Minimum 250 lbs. organic matter per cubic yard of compost.
 3. Carbon to nitrogen ratio: Maximum 35:1 if material is claimed to be nitrogen stabilized.
 4. pH: 5.5 – 8.0 as determined in saturated paste.
 5. Soluble Salts: See B. above.
 6. Moisture Content: 35-60%.
 7. Contaminants: The compost shall be free of contaminants such as glass, metal and visible plastic. Heavy meals, fecal coliform and Salmonella shall not exceed levels outlined as acceptable in the California integrated waste management regulations
 8. Maturity: Physical characteristics suggestive of maturity include:
 - a. Color: Dark brown to black.
 - b. Acceptable Odor: None, soil-like, or musty.
 - c. Unacceptable Odor: Sour, ammonia or putrid.
 - d. Particle Characterization: Identifiable wood pieces are acceptable but the balance of the material shall be soil-like without recognizable grass or leaves.
- E. Submit sample, product's technical data sheet, and analysis report from an approved soils laboratory for approval by the Owner's Representative. The analysis report should include compliance to the specifications above, directions for product use, and a list of ingredients. It is the Contractor's responsibility to secure test of the proposed composted yard waste amendment (2 quart sample) and submit to a Soils Laboratory for evaluation and recommendations. The composted yard waste amendment sample shall be a grab sample from the currently available material that has been tested within the last 30 days and shall include the composter's Compost Technical Data Sheet that includes lab analytical test results and directions for product use along with list of ingredients. Refer to Part 1 for soil testing requirements.
- F. Based on the Soils Laboratory evaluation, the addition of composted yard waste amendment shall not be acceptable if it creates a leaching requirement.

2.7 PLANTS

- A. Plant the variety, quantity and size indicated on drawings. The total quantities indicated on the drawings are considered approximate and furnished for convenience only. Contractor shall perform plant quantity calculations and provide all plants shown on the drawings.
- B. Measure trees and shrubs with branches in normal position. Height and spread dimensions indicated refer to the main body of the plant, and not from branch tip to tip.
- C. Take precautions to ensure that the plants will arrive at the site in proper condition for successful growth. Protect plants in transit from windburn and sunburn. Protect and maintain plants on site by proper storage and watering.

- D. Install healthy, shapely and well rooted plants with no evidence of having been root-bound, restricted or deformed.
- E. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.
- F. Substitutions will not be permitted, except as follows:
 - 1. If proof is submitted to the Owner's Representative that any plant specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety with an equitable adjustment of contract price.
 - 2. Substantiate and submit proof of plant availability in writing to the Owner's Representative within 10 days after the effective date of Notice to Proceed.
- G. Tree Form:
 - 1. Trees shall have a symmetrical form as typical for the species/cultivar and growth form.
 - 2. Central Leader for Single Trunk Trees: Trees shall have a single, relatively straight central leader and tapered trunk, free of co-dominant stems and vigorous, upright branches that compete with the central leader. Preferably, the central leader should not have been headed; however, in cases where the original leader has been remove, an upright branch at leas 1/2 the diameter of the original leader just below the pruning point shall be present.
 - 3. Potential Main Branches: Braches shall be evenly distributed radially around and appropriately spaced vertically along the trunk, forming a generally symmetrical crown typical for the species.
 - 4. Headed temporary branches should be distributed around and along the trunk as noted above and shall be no greater than 3/8" diameter, and no greater than 1/2 diameter of the trunk at point of attachment.
- H. Tree Trunk
 - 1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.
 - 2. Trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.
 - 3. Tree trunk diameter at 6" above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

Container	Trunk Diameter	Soil level from Container Top
5 gallon	0.5" to 0.75"	1.25 to 2"
15 gallon	0.75" to 1.0"	1.75 to 2.75"
24" Box	1.5" to 2. 5"	2.25 to 3"
36" Box	>2.5"	2.25 to 3"
60" Box	>2.5"	3-6"
 - 4. Tree trunks shall be undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.
- I. Tree Roots
 - 1. Trunk root collar (root crown) and large roots shall be free of circling and/or kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and/or kinked roots are not present.
 - 2. The tree shall be well rooted in the container. When the trunk is lifted the trunk and root system shall move as one and the rootball shall remain intact.
 - 3. The top-most roots or root collar shall be within 1" above or below the soil surface. The soil level in the container shall be within the limits shown in above table.
 - 4. The rootball periphery shall be free of large circling and bottom-matted roots.
 - 5. On grafted or budded trees, there shall be no suckers from the root stock.

2.8 FERTILIZERS

- A. Synthetic Controlled Release Fertilizer: Not permitted.
- B. Organic Fertilizer: Compost Tea Bags or Root Zone Feeder Paks, 4-6-4, Sustane Natural Fertilizer of America, Inc. 1 (507) 263.3003, www.sustane.com. Follow manufacturer's instructions for quantity and placement.
- C. Any other soil conditioner and/or fertilizer required by the Soils Analysis Report. If commercial fertilizer having the above analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the approval of the Owner's Representative.
- D. Palm Tree Fertilizer: "Turf type" balanced fertilizer with nitrogen sources which allow fast, medium, and slow release. The fertilizer shall contain a full range of micronutrients and shall be as recommended or as approved by the palm tree supplier. Minor elements shall include the following elements in the approximate amounts: 6.69% Mg, 3.87% Mn, 2.41% Zn, 4.00 % Fe, 4.24% combined Sulfur as S, .03% B and .0002% Mo.

2.9 EROSION CONTROL NETTING

- A. New, with a uniform, open plain-weave, flame-retardant mesh. The mesh shall be [natural brown-tan] and made from unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Furnish jute mesh in rolled strips to meet the following requirements:
 - 1. Width: 48 inches, with a tolerance of one-inch wider or narrower. Not less than 78 warp ends per width.
 - 2. Not less than 41 weft ends per yard.

2.10 PERFORATED DRAIN PIPE

- A. Polyvinyl Chloride (PVC) pipe and pipe fittings shall meet extra strength minimum of SDR-35 of the requirements of ASTM Specification D3034.
- B. Perforated and non-perforated corrugated polyethylene pipe, 3- to 10-inch diameter, shall meet the requirements of ASTM D883 and ASTM F412, and shall conform to Section 68 of the Standard Specifications.
- C. Corrugated polyethylene pipe fittings shall comply with all requirements of AASHTO M-252-85I for 3- to 10-inch diameter pipe. Couplings shall be split or snap-on type for perforated pipe and split couplings with gaskets for non-perforated pipe. Cutting pipe with integral couplings will not be allowed.
- D. Corrugated polyethylene pipe and fittings manufactured by Advanced Drainage Systems, Inc., shall be considered the standard to determine compliance to this specification.
- E. Inspection Tube Cap: Paint cap one coat chocolate-brown color using Flat, exterior grade latex paint as accepted by Owner's Representative.

2.11 FILTER FABRIC / PERMEABLE LANDSCAPE FABRIC

- A. Polyester or polypropylene non-woven filter fabric with uniform fiber distribution by "Terra Bond" #1115, "Mirafi, Inc." #140N, or approved equal.

2.12 PERMEABLE DRAIN ROCK

- A. Permeable drain rock used in subsurface drain installations to be Class 2 permeable material in conformance with Section 68 "Subsurface Drains" of the Standard Specifications; gradation to 3/4" maximum size. Submit Sample for approval.

2.13 ROOT BARRIER

- A. UB 24 as manufactured by Deep Root Corporation (800)458-7668, Root Solutions, Inc. (800) 554-0914, or equal. Install a minimum of 6 panels/12 linear feet centered on each tree, where tree is within 8 feet of sidewalk, paving, or utilities.

2.14 HEADER BOARD

- A. Redwood: 2x4 on all straight sections and 1x4 doubled or 1/4x4 four times on all radius sections.

2.15 PRE-EMERGENCE WEED KILLER, HERBICIDES, INSECTICIDES, AND FUNGICIDES

- A. Clean non-staining as recommended by a licensed pest control specialist and approved by Owners Representative.

2.16 TREE STAKES

- A. Lodge pole pine logs, clean, smooth, un-treated.
- B. Unless otherwise shown on drawings, provide two-inch (2") diameter by eight feet (8') long for trees less than 8' high and 1" caliper.
- C. Unless otherwise shown on drawings, provide three-inch (3") diameter by eight to ten feet (8' - 10') long for trees greater than 8' high and 1" caliper.

2.17 TREE TIES

- A. Unless otherwise shown on drawings, provide rubber strap, 24-inch minimum length without sharp edges adjacent to trunk, V.I.T. cinch-tie, Dublin, CA, (818)882-9530, or approved equal.
- B. Black corded rubber tree ties w/ clips by greensleeves.com
- C. Biodegradable VStrap webbing by Treestrap.

2.18 TREE GUYING SYSTEM:

- A. For trees up to 3" caliper, 3/16" galvanized steel cable, with rubber tree collar, 12" minimum long, and secured with cable clamp, and attached to anchor for below-grade location, Duckbill Model 40 DTS, or approved equal.
- B. For trees 3" to 6" caliper, 3/16" galvanized steel cable with rubber tree collar, 18" minimum long, and secured with cable clamp, 3" take-up eye to eye turnbuckle, and attached to anchor for below-grade location, Duckbill Model 68 DTS, or approved equal.
- C. Rootball guying system with three dead man anchors per tree as shown on drawings.

2.19 VINE SUPPORT SYSTEM:

- A. Provide vertical supports for all vines as required for vines to climb onto shown horizontal supports (trellis, arbor, etc.). Vertical support shall be 3/16" stainless steel cables secured taut with in-line end fasteners at ground and top of structure. Anchor cable at ground with 1 inch by 15 inch galvanized pipe stake driven flush with drilled hole to receive the cable. Train vine branches to supports with green nursery tape.

2.20 MULCH

- A. Organic Bark Mulch, derived from recycled green waste and screened to 1" – 3" in size, Zankercycling.com, 408.846.1577 or equal.
- B. Submit samples of rock mulch for approval by Owner's Representative until acceptable.

2.21 REPLACEMENT MATERIALS

- A. Materials in need of replacement such as tree stakes and ties are to match originally accepted materials on the site.

PART 3 - EXECUTION

3.1 PLANT PROTECTION AND REPLACEMENT

- A. Inspect and protect all existing and new plants and trees against damage from construction activities, erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodent and applying protective sprays and fencing to discourage deer browsing. Maintain and keep all temporary barriers erected to prevent trespass.
- B. Repair all damaged planted areas. Replace plants and re-seed or re-sod turf immediately upon discovery of damage or loss.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Fertilizers and Amendments: Store fertilizers and amendments, bark mulch, soil mix, and other materials which could stain concrete and similar surfaces in such a manner that staining does not occur.
- B. Deliver, store, protect and handle products to site under Section 1007 Planting, SSDPWSF.
- C. Deliver fertilizer and other bulk products in waterproof bags showing date, weight, chemical analysis and name of manufacturer.
- D. Prevent spillage when hauling on or adjacent to any public street or highway. In the event that spillage occurs, remove all spillage and sweep, wash, or otherwise clean such streets or highways as required by local City, County and/or the State Authorities.
- E. Take precautions to prevent a dust nuisance to adjacent public or private properties and to prevent erosion and transportation of soil to downstream or adjacent properties due to work under this Contract. At project site exit, clean dirt from tires. Do not track dirt onto roadways.

- F. Prior to delivery, propose suitable stockpile locations. Stockpile to a 6-foot high maximum and protect from traffic, wind and water erosion. Provide temporary seeding and/or erosion control measures as approved by Owner's Representative.

3.3 TOPSOIL STRIPPING AND STOCKPILING:

- A. Strip existing planting soil to whatever depths encountered in areas that may be compacted due to construction activities and in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area outside "Drip Line" of existing trees to remain and areas indicated on drawings and as approved by the Owner's Representative.
- B. Remove heavy growths of grass from areas before stripping.
- C. Stockpile existing planting soil in storage piles in areas shown, or where designated by Owner. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.
- D. If herbicide contamination is suspected then a radish/ryegrass growth trial must be performed. Consult with Owner's Representative prior to decision to test or not.

3.4 LIME TREATED SOIL

- A. If site work includes Lime Treatment of the subsoil, the Contractor shall remove full depth of treated soil beyond 12" from structure(s) and replace with approved planting soil. Following removal of lime treated material, scarify subgrade to a minimum depth of 6 inches and test for drainage.
- B. Test subgrade in all planting areas for drainage by flooding with minimum 4 inch depth of water puddle and verify complete absorption of standing water within two hours. If standing water is still present after two hours, provide perforated pipe and drain rock "French Drain" system in bottom of non-draining planters and connect to storm drainage system, as accepted by Owner's Representative prior to backfilling with approved planting soil.

3.5 LANDSCAPE FINISH GRADING

- A. Perform grading within contract limits, including adjacent transition areas, to new elevations, levels, profiles and contours indicated. Conform to existing grades at edges of Work as accepted by Owner's Representative. Provide subgrade surfaces parallel to finished surface grades. Provide uniform levels and slopes between new elevations and existing grades.
- B. After clearing subgrade of all vegetation and debris in accordance with section 16 of the Standard Specifications, scarify subgrade to a depth of at least 6" below final subgrade elevation, harrow, dry roll and break clods to achieve a finely divided condition. Remove all boulders, hardened material or rock encountered.
- C. Adjust finish elevation of utility lids and manhole covers to ensure slope of adjacent planting area does not exceed 3:1.
- D. Hold finish grade of soil in planting areas 1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. The subgrade of the mulch in mulched planting areas shall be a minus 3 inches at a distance of 12 to 18 inch from the edge of pavement. Drag finish grade to a smooth, even surface. Grade to form all swales and berms. Pitch grade with uniform slope to catch basins, streets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly sloped between finish elevations.

Slope surface away from walls so water will not stand against walls or buildings. Control surface water to avoid damage to adjoining properties or to finished work on the site. Take required remedial measures to prevent erosion of freshly graded areas.

- E. Grade surfaces to assure areas drain away from structures and to prevent ponding and pockets of surface drainage. Provide subgrade surfaces free from irregular surface changes and as follows:
 - 1. Provide subgrade surface free of exposed boulders or stones exceeding 4" in greatest dimension.
 - 2. Lawn and Planting Areas: Allow for 12 inches average depth of topsoil at lawn areas, and 12 inches depth at planting areas, except as otherwise indicated on the drawings.
 - 3. Provide earth mounding where indicated.
 - 4. Drainage Swales: Grade to profiles indicated
- F. Grading at existing trees to remain:
 - 1. Perform grading, within branch spread of existing trees to remain, by hand methods to elevations indicated.
 - 2. If roots are damaged, cut roots cleanly to depth 3" below proposed finish grade.
- G. Tolerances
 - 1. Handle and place the soil and amended backfill to required depths as shown on Drawings and stated herein.
 - a. Deposit amended backfill in horizontal lifts not exceeding 12 inches. Moisten to settle. Compact or roll each lift to 85 percent relative compaction.
 - 2. Work soil and amended backfill sufficiently so that after rolling, and after full settlement has occurred, the site will be graded to within +0.10 of a foot from the lines, grades, and elevations shown, and as may be directed by the City Representative. Finished surface shall be smooth and uniform, and shall be free of depressions that retain standing water, or any surface irregularities that would impede proper drainage.
 - 3. Unless otherwise noted, finish grade for all planting areas and tree pits shall allow for a two inch mulch layer, set 1/2 inch below top of adjacent walks, pavement, curbs, and walls.

3.6 GENERAL PREPARATION OF PLANTING SOIL

- A. Submit soil analysis report of amended soils from an approved soils laboratory for approval by the Owner's Representative. Refer to Part 1 for soil testing requirements.
- B. All planting soils to be amended as specified in soil laboratory analysis report(s).
- C. Provide a minimum of [12"] depth of amended planting soil in all planting areas, or more where shown or specified otherwise. Install soil in maximum [12"] lifts. Compact each lift prior to installing subsequent lifts.
- D. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.
- E. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 1 inch and larger in size in turf areas and 2 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Owner's Representative before any planting.

- F. Prior to planting, soil shall be loose and friable to a minimum depth of [12"] with a relative maximum compaction of 85%. Rip and scarify any overly compacted and re-compacted planting areas (in two directions full depth of compacted soil) prior to planting.
- G. Water settling, puddling, and jetting of soil and backfill materials as a compaction method is not acceptable.
- H. Prior to planting, soil shall be moist, but not so moist that it sticks to a hand shovel. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.
- I. Provide planting soil as a final lift in all planting areas within and adjacent to paved areas and other construction where native site soil has been covered by engineered fill and/or base rock. Unless otherwise shown or specified, finish grade in planting islands shall be crowned with a minimum 2% pitch to drain.
- J. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.

3.7 PREPARATION OF IN-SITU PLANTING SOIL

- A. In-Situ Planting Soil is defined as top soil left in it's original place and undisturbed during construction activities which is to receive new planting
- B. Except within tree driplines, rip all planting areas in two directions full depth to a minimum of [12"] into undisturbed native subsoil prior to amending. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Owner's Representative to the specified depth to ensure proper percolation/drainage.
- C. Inspect planting areas and remove all base rock and other foreign material. Verify placement of planting soil within dripline of trees with Owner's Representative.
- D. Test depth of loose soil with hand shovel in presence of Owner's Representative in several locations as directed.
- E. After acceptance of the planting condition, uniformly mix and amend soil with required fertilizers, nutrients, etc. per specifications herein and recommendations given in soils reports.
- F. In the case of a contradiction between the quantity of organic amendment required by the soils laboratory analysis and the specified quantity below, the greater of the two quantities shall take precedence. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded on-site topsoil in all planting areas including turf, ground cover and shrub areas at the following rates:
 - 1. Organic Amendment: 6 cubic yards per 1,000 square feet
 - 2. Fertilizer: Type A (6-20-20) at 20 lbs. per 1,000 square feet.
 - 3. Iron Sulfate: 10 lbs. per 1,000 square feet
- G. Rototill above additives into soil [8-12"] inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.
- H. Final planting soil shall have a pH range of 6.5 to 7.5.

3.8 PREPARATION OF IMPORTED PLANTING SOIL (ON-GRADE)

- A. Uniformly distribute and spread Subsoil or select fill in planting areas to achieve rough grading and compact to a maximum of 85% relative compaction.
- B. Except within tree driplines, rip all planting areas in two directions full depth to a minimum of [12"] into undisturbed native subsoil prior to backfilling. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Owner's Representative to the specified depth to ensure proper percolation/drainage.
- C. Thoroughly water-settle subsoil to required subgrade prior to installing Top Soil.
- D. Prior to placing planting soil secure the Owner's Representatives acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of Owner's Representative in several locations as directed.
- E. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade in planting areas as specified.
- F. Mix and amend soil with required fertilizers, nutrients, etc. per specifications herein and recommendations given in soils reports.

3.9 WEED GERMINATION

- A. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate.
- B. Following soil preparation and fine grading of planting areas, irrigate the planting areas to germinate any weed seeds for a minimum period of 21 days. Maintain the soil in a damp condition for a minimum depth of 4 inches. Following approval of the weed germination by the Owner's Representative, spray kill the weeds using a short lived systemic weed killer that will not affect subsequent planting. Confirm the weed kill and allow the soil to dry out to optimum degree for planting prior to planting.

3.10 PRE-EMERGENCE WEED KILLER

- A. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate.
- B. Apply pre-emergence weed killer in all areas to receive ground cover planting. Obtain approval of the finish grades prior to applying weed killer and coordinate planting and watering with the pest control specialist prior to planting. Take care to keep weed killer off areas to be seeded.

3.11 ROOT BARRIER

- A. Install in continuous sheet parallel and adjacent to curb or pavement edge as required on drawings and in accordance with manufacturer's recommendations. Set top of barrier approximately 1/2-inch above finished soil surface to allow concealment with mulch, as accepted by Owner's Representative

3.12 EROSION CONTROL NETTING

- A. Verify finished grades and provide Jute Mesh and single grind Redwood bark mulch on all slopes 3:1 and steeper as accepted by the Owner's Representative. Install jute mesh loosely up and down the slope in accordance with manufacturer's specifications and as follows. Fit the soil surface contour and hold in place with 12-inch long, 11-gauge (minimum) steel wire staples driven vertically into the soil at 18- to 24-inch spacing. Jute mesh strips shall overlap along all edges at least 6 inches. Ends of side strips shall be buried into the soil at least 6 inches. Drive staples along edges to securely anchor mesh to ground.

3.13 HEADER BOARD

- A. Install in continuous, smooth alignment as indicated with stakes spaced 48 inches on center maximum and at all joints.

3.14 TREE AND SHRUB PLANTING

- A. Mark tree and shrub locations on site using stakes, gypsum or similar approved means and secure location approval by the Owner's Representative before plant holes are dug. Adjust location as required prior to planting.
- B. Review location of plants in relationship to irrigation heads and adjust location(s) that interfere with the function of the spray heads. Adjust locations as required to ensure that the plant roots receive the proper amount of water in order for the plants to thrive.

C. Square Tree Pits

1. Drilled tree pits shall be modified to a square pattern with pit walls scarified to promote root penetration.

D. Excavate tree, shrub and vine pits as follows:

	Width	Depth
Boxed Trees	Box + 24"	Box depth
Canned Trees (15 gc)	Can + 18"	Can depth
Canned Shrubs/Vines (1- 5 gc)	Can + 12"	Can depth

- E. Test drainage of plant beds and tree pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than two (2) hours shall be brought to the attention of the Owner's Representative. If rock, underground construction work, tree roots, poor drainage, or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by Owner's Representative.
- F. Break and loosen the sides and bottom of tree pits to ensure root penetration and water test hole for drainage as required above.
- G. Excavate plant hole or tree pit keeping excavated planting soil layer on the surface when backfilling around the plant. Carefully set plants as detailed without damaging the rootball. Superficially cut edge roots vertically on three sides. Remove bottom of plant boxes before planting. Remove sides of boxes after positioning the plant and partially backfilling.
- H. Set plants in backfill with top of the rootball 1 inch above finished grade of adjacent soil. Backfill remainder of hole and soak thoroughly by jetting with a hose and pipe section. Water backfill until saturated the full depth of the hole.

- I. Backfill plant holes with mix as specified, free from rocks, clods or lumpy material. Backfill native soil free of soil amendments under rootball and foot tamp to prevent settlement. Backfill remainder of the hole with soil mix
- J. Use a soil mix of 2 parts soil from the hole, and 1 part amendment with iron added at the following rates:

1 gallon can plants	iron, 1/4 cup
5 gallon can plants	iron, 1/3 cup
15 gallon can plants	iron, 1/2 cup
24" box and larger	iron, 1 cup

 1. Mix the iron, amendment and soil thoroughly for use in the top 8 inches of backfill around plants. For acid loving plants, mixture to be 1/2 soil from the hole and 1/2 amendment.
- K. Remove any soil from top of plant rootballs and secure Owner's Representative approval of rootball height prior to mulching.
- L. After approval of rootball height, install mulch as required below.
- M. Stake and/or guy trees as detailed. Drive stake(s) until solid (at least 12" beyond bottom of rootball) and remove excess stake protruding above top tree tie to prevent rubbing against branches. Avoid driving stakes through rootball. If subgrade does not accept stakes to a stable degree, delete stakes and guy the trees as specified herein and as detailed. Locate tree ties to avoid contact with tree branches. Locate top tie at tree flex point.
- N. Build watering basin berms around trees and shrubs to drain through rootball. Basins are not required around trees in turf areas. Water backfill until saturated the full depth of the hole.

3.15 PALM TREE PLANTING

- A. Holes for palm trees shall be dug in a square configuration and size as shown on drawings.
- B. Flood the excavated tree holes with 6 inches of water and verify that it has completely drained within 2 hours. Notify Owner's Representative of any wet or impervious soil conditions that might adversely affect the tree's ability to survive and resolve the problem as approved by the Owner's Representative prior to proceeding with the planting.
- C. While palms are still in horizontal position, spray crown to point of runoff with 3336f fungicide by W. A. Clearly Chemical Co. to prevent Penicillium Rot. Provide follow-up spraying as required until the trees become established.
- D. Remove the fronds ties at time of planting.
- E. While the tree is hooked and held plumb by the crane, backfill with 100% specified backfill without additives. Position the tree plumb and the height of the rootball at its original grade and compact the sand bedding underneath sufficiently to prevent settlement of the rootball. Water and compact sand around and under rootball sufficiently to eliminate any air pockets. Reposition tree and re-compact the sand if it settles or becomes out of plumb.
- F. Maintain the rootball in a moist condition prior to and after planting. Do not cover rootballs with plastic or soil. Do not apply vitamin B1 or other "transplant Shock" materials.
- G. Temporarily brace the tree as site conditions require using a padded wooden collar around the trunk with braces nailed to the collar. Do not nail into tree trunk.

- H. Drench the root zone with a broad-spectrum fungicide labeled for landscape use on soil borne diseases for Palms. After this initial application, apply the fungicide 3 more times as recommended by the label during the first few months. Cover soil surface around tree with mulch as specified.
- I. All existing and new palm trees: Hold turf a minimum of 18" away from trunk and adjust irrigation so that water does not spray onto trunk.

3.16 GROUND COVER PLANTING

- A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row one-half required ground cover spacing behind adjacent curbs, structures, or other plant bed limits. Plant ground cover to edge of water basins of adjacent trees and shrubs.

3.17 MULCH:

- A. Mulch all tree, shrub and ground cover areas with mulch to a 3-inch depth.
- B. Hold bark mulch away from base (trunk) of plant 4" or as directed by the Owner's Representative.
- C. Individual trees and/or shrubs planted in non-irrigated areas shall, at minimum, receive bark mulch over their watering basin and berm.

3.18 WATERING:

- A. Water all trees, shrubs and ground cover immediately after planting. Apply water to all plants as often and in sufficient amount as conditions may require to keep the plants in a healthy vigorous growing condition until completion of the Contract. Provide supplemental hand watering of trees and shrubs, as required, to maintain a moist root zones throughout plant establishment period.

3.19 PRE-MAINTENANCE PERIOD REVIEW AND APPROVAL OF PLANTING

- A. Maintain plants from time of delivery to site until final acceptance of landscape installation.
- B. Receive approval of the installed planting prior to commencement of planting establishment maintenance period. Notify the Owner's Representative a minimum of seven (7) days prior to requested review. Before the review, complete the following:
 - 1. Complete all construction work.
 - 2. Present all planted areas neat and clean with all weeds removed and all plants installed and appearing healthy.
 - 3. Plumb all trees and tree and shrub supports.
 - 4. No partial approvals will be given.

3.20 PLANTING ESTABLISHMENT MAINTENANCE:

- A. General Requirements:
 - 1. Maintenance Period: The planting establishment maintenance period required shall be [365 calendar days] after all planting and irrigation is complete, turf is installed/seeded, and as approved by Owner's representative. A longer period may be required if the turf is not thick, vigorous and even and has been mowed a minimum of 4 times, or if the plant material is not acceptably maintained during the maintenance period. The start of the maintenance period to be confirmed by Owner's representative. Contractor to notify Owner's Representative of start and end dates of maintenance period. The maintenance

period may be suspended at any time upon written notice to the Contractor that the landscaping is not being acceptably maintained, and the day count suspended until the landscape is brought up to acceptable standards as determined by the Owner's Representative.

2. Planting establishment maintenance immediately follows, coincides with, and is continuous with the planting operations, and continues through turf installation, and after all planting is complete and accepted; or longer where necessary to establish acceptable stands of thriving plants.
3. Protect all areas against damage, including erosion, trespass, insects, rodents, disease, etc. and provide proper safeguards. Maintain and keep all temporary barriers erected to prevent trespass.
4. Keep all walks and paved areas clean. Keep the site clear of debris resulting from construction or maintenance activities.
5. Repair all damaged planted areas, and replace plants and resod turf immediately upon discovery of damage or loss.
6. Check sprinkler systems at each watering; adjust coverage and clean heads immediately. Adjust timing of sprinkler controller to prevent flooding.
7. Maintain adequate moisture depth in soil to ensure vigorous growth. Check rootball of trees and shrubs independent of surrounding soils and hand water as required.
8. Keep contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds at all times.

B. Tree and Plant Maintenance:

1. Maintain during the entire establishment period by regular watering, cultivating, weeding, repair of stakes and ties, and spraying for insect pests. Prune when requested by the Owner's Representative.
2. Keep watering basins in good condition and weed-free at all times.
3. Replace all damaged, unhealthy or dead trees, shrubs, grasses, vines and ground covers with new stock immediately; size as indicated on the drawings.

C. Palm Tree Maintenance:

1. Do not over water palm trees. Do not use a predetermined watering schedule for the palms. Use a soil probe to determine optimum soil moisture level within the rootball.
2. Palm Tree Fertilizing: After palms show new frond growth, approximately 6 to 8 weeks after planting, apply specified balanced fertilizer with trace elements. Repeat application after 3 to 4 months. Established palms shall be fertilized spring and fall.
3. Check palms for plumb and re-plumb as required.
4. Check palms periodically for Penicillium Rot and Fusarium Wilt. If the apical bud has fallen over (Penicillium Rot symptom) or Fusarium Wilt is suspected, remove the affected tree immediately.
5. Reapply broad-spectrum fungicide labeled for landscape use on soil borne diseases for Palms as noted herein under Palm Tree Planting.

D. Fertilizing:

1. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize all turf and ground cover areas by broad-casting Type C (21-7-14) fertilizer at the rate of 5 lbs. per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.
2. During the winter, for quick turf greening effect, calcium nitrate (15.5-0-0) may be applied at the rate of 6 lbs. per 1,000 square feet.
3. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 lbs. per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
4. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizations mentioned above.

5. Observe plant's color, and if a soil pH imbalance is suspected, take soil samples and obtain laboratory analysis for confirmation. Take necessary action recommended in laboratory analysis such as top dressing with soil sulfur, leaching soil, etc.

E. Irrigation:

1. The entire irrigation system shall be under full automatic operation and adjust as needed during the plant maintenance period to ensure healthy, thriving plants.

3.21 FINAL PLANTING REVIEW AND ACCEPTANCE

- A. Final acceptance and start of warranty period will occur no earlier than the end of the plant maintenance period.
- B. At the conclusion of the Maintenance Period, schedule a final review with the Owner, the Owner's maintenance person, and/or the Owner's Representative. On such date, all project improvements and all corrective work shall have been completed. If all project improvements and corrective work are not completed, continue the planting establishment maintenance period at no additional cost to the Owner until all work has been completed. This condition will be waived by the Owner under such circumstances wherein the Owner has granted an extension of time to permit the completion of a particular portion of the work beyond the time of completion set forth in the Agreement.
- C. Submit written notice requesting review at least 10 days before the anticipated review.
- D. Prior to review, weed and restore all planted areas, mow and edge turf, plumb trees and tree supports, clear the site of all debris and present in a neat, orderly manner.

END OF SECTION

SECTION 33 1000

WATER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to on-site domestic water and fire water systems serving all buildings and appurtenances. Unless otherwise noted, this section does not apply to irrigation water systems and water systems inside and within 5 feet of buildings. This section applies to:
 - 1. Domestic water distribution and services.
 - 2. Fire water distribution and services.
 - 3. Water storage tanks.
- B. Contractor shall provide all labor, equipment, materials, and testing services unless otherwise noted.
- C. Related Sections:
 - 1. Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING.
 - 2. Section 26 4200 – CATHODIC PROTECTION
- D. Water pressure data:
 - 1. Provided by: Sandis
 - 2. Testing Date: August 2019
 - 3. Location: End of Facilities Rd at Cul-De-Sac
 - 4. Static Pressure: 83 psig
 - 5. Residual Pressure: 52 psig
 - 6. Flow: 1130 gpm
 - 7. Orifice Size: 2.5 inch
 - 8. Contractor shall notify Engineer if actual water pressure encountered varies by ± 10 psig.

1.2 SUBMITTALS

- A. Comply with requirements of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Product Data: Manufacturer's literature and data, including, where applicable, sizes, pressure rating, rated capacity, listing/approval stamps, labels, or other marking on equipment made to the specified standards for materials, and settings of selected models, for the following:
 - 1. Piping and fittings.
 - 2. Gaskets, couplings, sleeves, and assembly bolts and nuts.
 - 3. Gate valves and ball valves.
 - 4. Blow-off valves, air release and vacuum valves, and combination air valves.
 - 5. Check valves.
 - 6. Pressure reducing valves.
 - 7. Backflow preventers.
 - 8. Valve boxes, frames and covers.
 - 9. Water meter boxes, frames and covers.
 - 10. Post indicators.
 - 11. Fire department connections and wet stand pipes.
 - 12. Fire hydrants.
 - 13. Thrust block concrete mix and/or restrained joints and fittings.

14. Tapping sleeves and tapping valves.
 15. Service saddles and corporation stops.
 16. Identification materials and devices.
 17. Corrosion protection.
 18. Water sampling stations.
- C. Shop Drawings and Calculations: Where an on-site fire water system is required, Contractor shall provide shop drawings for engineer and agency approval prior to construction. Coordinate with the Contract Documents and identify any proposed modifications or deviations. Shop Drawings and Calculations shall be stamped and signed by a registered Fire Protection Engineer licensed by the State of California.
1. Include the following information:
 - a. Design assumptions.
 - b. Thrust block sizing and calculations.
 - c. Materials to be used.
 - d. Available water pressure.
 - e. Required water pressure.
 2. The review of fire system components constitutes only a portion of the review and approval required. A copy of the fire system component submittal package shall be forwarded by the Contractor to the Local Fire Authority for further review and approval.
- E. Test Reports:
1. Bacteriologic Testing: Provide copies of the test results indicating water sample meets California Drinking Water Standards.
- F. Samples: None specified. Provide as necessary.

1.3 QUALITY ASSURANCE

- A. Comply with the latest edition of the following Standards and Regulations:
1. American Water Works Association (AWWA) and American National Standards Institute (ANSI):
 - a. C104/A21.4 ANSI Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. C105/A21.5 ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. C110/A21.10 ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 inch - 48 inch for Water.
 - d. C111/A21.11 ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. C115/A21.15 ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - f. C116/A21.16 ANSI Standard for Protective Fusion-Bonded Epoxy Coatings Interior & Exterior Surfaces for Ductile-Iron and Gray-Iron Fittings.
 - g. C150/A21.50 ANSI Standard for Thickness Design of Ductile-Iron Pipe.
 - h. C151/A21.51 ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - i. C153/A21.53 ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
 - j. C500 Metal-Seated Gate Valves for Water Supply Service.
 - k. C502 Dry-Barrel Fire Hydrants.
 - l. C503 Wet-Barrel Fire Hydrants.
 - m. C504 Rubber-Seated Butterfly Valves.
 - n. C507 Ball Valves, 6 inches - 48 inches.
 - o. C508 Swing-Check Valves for Waterworks Service, 2 inches - 24 inches NPS.

- p. C509 Resilient-Seated Gate Valves for Water Supply Service.
 - q. C510 Double Check Valve Backflow Prevention Assembly.
 - r. C511 Reduced-Pressure Principle Backflow Prevention Assembly.
 - s. C512 Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - t. C550 Protective Epoxy Interior Coating for valves and Hydrants.
 - u. C600 Installation of Ductile-Iron Water Mains and their Appurtenances.
 - v. C602 Cement- Mortar Lining of water Pipelines in place- 4 inches and larger.
 - w. C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - x. C651 Disinfecting Water Mains
 - y. C652 Disinfection of Water-Storage Facilities
 - z. C800 Underground Service Line Valves and Fittings for 1/2 inches - 2 inches.
 - aa. C900 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 inches - 12 inches, for Water Distribution.
 - bb. C901 Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inches through 3 inches, for Water Service.
 - cc. C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inches - 48 inches.
 - dd. C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 inches - 63 inches, for Water Distribution and Transmission.
 - ee. C907 Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 inches - 8 inches.
 - ff. C908 PVC Self-Tapping Saddle Tees for Use on PVC Pipe.
 - gg. D103 Factory-Coated Bolted steel Tanks for water Storage.
2. National Fire Protection Association (NFPA):
 - a. NFPA 13 Standard for the Installation of Sprinkler Systems.
 - b. NFPA 14 Standard for the Installation of Standpipe, Private Hydrants, and Hose Systems.
 - c. NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection.
 - d. NFPA 22 Standard for Water Tanks for Private Fire Protection.
 - e. NFPA 24 Private Service Mains and their Appurtenances.
 - f. NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 3. Uni-Bell Plastic Pipe Association (UNI).
 - a. PUB 3 PVC Pipe – Technology Serving the Water Industry.
 - b. PUB 7 External Corrosion of Underground Water Distribution Piping Systems.
 - c. PUB 8 Tapping Guide for AWWA C900 Pressure Pipe.
 - d. PUB 9 Installation Guide for PVC Pressure Pipe.
 - e. B-8 Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 inch).
 4. American Society of Testing and Materials (ASTM).
 - a. ASTM A536 Standard Specification for Ductile Iron Castings.
 - b. ASTM A674 Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
 - c. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - d. ASTM D2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe.
 - e. ASTM D2466 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - f. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - g. ASTM D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
 - h. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

- i. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - j. ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - k. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - l. ASTM F1055 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
 - m. ASTM F1056 Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
 - n. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - o. ASTM A795 Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - p. ASTM A865 Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints.
 - q. ASTM B88 Standard Specification for Seamless Copper Water Tube.
5. American Society of Mechanical Engineers (ASME).
 - a. ASME B16 series for valves, fittings, flanges, and gaskets applicable for use in water systems.
 - b. ASME B1.20.1 American Standard Tapered Pipe Threads for factory-threaded pipe and pipe fittings.
 6. National Sanitation Foundation (NSF).
 - a. NSF/ANSI 14 Plastics Piping System Components and Related Materials.
 - b. NSF/ANSI 61 Standard for Drinking Water Systems Components – Health Effects.
 7. Underwriters Laboratories, Inc. (UL).
 - a. UL 157 Standard for Safety for Gaskets and Seals.
 - b. UL 194 Standard for Safety for Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service.
 - c. UL 213 Rubber Gasketed Fittings for Fire-Protection Service.
 - d. UL 246 Standard for Safety for Hydrants for Fire-Protection Service.
 - e. UL 262 Standard for Safety for Gate Valves for Fire-Protection Service.
 - f. UL 312 Standard for Safety for Check Valves for Fire-Protection Service.
 - g. UL 405 Standard for Safety for Fire Department Connections.
 - h. UL 448 Standard for Safety for Pumps for Fire-Protection Service.
 - i. UL 789 Standard for Safety for Indicator Posts for Fire-Protection Service.
 - j. UL 860 Pipe Unions for Flammable and Combustible Fluids and Fire-Protection Service.
 - k. UL 1091 Standard for Safety for Butterfly Valves for Fire-Protection Service.
 - l. UL 1285 Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service.
 - m. UL 1468 Direct Acting Pressure Reducing and Pressure Restricting Valves.
 - n. UL 1478 Standard for Safety for Fire Pump Relief Valves.
 8. FM Global (FM).
 - a. FM 1020 Automatic Water Control Valves.
 - b. FM 1045 Waterflow Detector Check Valves.
 - c. FM 1110 Indicator Posts.
 - d. FM 1111 Post-Indicator-Valve-Assembly.
 - e. FM 1112 Indicating Butterfly Valves.
 - f. FM 1120 and FM 1130 Fire Service Water Control Valves (OS&Y and NRS Type Gate Valves).
 - g. FM 1210 Swing Check Valves.
 - h. FM 1221 Backflow Preventers (Reduced Pressure Principle and Double Check Valve Types).
 - i. FM 1311 Centrifugal Fire Pumps (Horizontal, Split-Case Type).

- j. FM 1312 Centrifugal Fire Pumps (Vertical-Shaft, Turbine Type).
 - k. FM 1319 Centrifugal Fire Pumps (Horizontal, End Suction Type).
 - l. FM 1361 Water Pressure Relief Valve.
 - m. FM 1362 Pressure Reducing Valves.
 - n. FM 1371 Centrifugal Fire Pumps (In-Line Type).
 - o. FM 1510 Fire Hydrants (Dry Barrel Type) for Private Fire Service.
 - p. FM 1511 Fire Hydrants (Wet Barrel Type) for Private Fire Service.
 - q. FM 1530 Fire Department Connections.
 - r. FM 1610 Plastic Pipe & Fittings for Underground Fire Protection Service.
 - s. FM 1620 Pipe Joints & Anchor Fittings for Underground Fire Service Mains.
- 9. Plastics Pipe Institute (PPI).
 - a. Underground Installation of Polyethylene Pipe.
 - b. Polyethylene Joining Procedures.
 - c. Inspections, Test and Safety Considerations.
 - 10. American Association of State Highway and Transportation Officials (AASHTO) for H2O Loading.
 - 11. American Concrete Institute (ACI).
 - a. ACI 348 - Meter Pit Construction.
 - 12. City of Livermore Standard Specifications and Details.
 - 13. Livermore – Pleasanton Fire Department Regulations.
 - 14. Other authorities having jurisdiction.
- B. System Description: Grades and elevations are to be established with benchmarks referenced on Plans.
 - C. Comply with City of Livermore Standards and authorities having jurisdiction for the installation and testing of potable water piping and fire protection systems.
 - D. Comply with City of Livermore Standards and authorities having jurisdiction for the installation, testing and separation requirements of recycled/reclaimed water piping [and fire protection systems.]]
 - E. All testing of systems specified in this section shall be witnessed by representatives of the local water department or local authority. Provide at least 7 days notice.

PART 2 - PRODUCTS

2.1 PIPING

- A. Water Distribution Main (pipe size 4 inches and larger).
 - 1. Ductile Iron Pipe (DIP): Pressure Class 350 pipe conforming to AWWA/ANSI C151/A21.5, cement-mortar lining conforming to AWWA/ANSI C104/A21.4, with standard thickness per AWWA/ANSI C150/A21.50. U.S. Pipe, American Cast Iron Pipe Company (ACIPCO), or approved equivalent.
 - a. Flanged ends shall conform to AWWA/ANSI C115/A21.15.
 - b. Rubber-gasket joints shall conform to AWWA/ANSI C111/A21.11.
 - 2. Polyvinyl Chloride Pipe (PVC): Pressure Class 235, DR 18, spigot and gasket bell end, conforming to AWWA C900 or AWWA C905, with equivalent cast-iron pipe outer diameter (O.D.). J-M Manufacturing, PW Pipe, North American Pipe Company, or approved equivalent.
 - 3. Polyethylene Pipe (PE): PE 4710, ASTM F714, Pressure Class 200, DR 9, conforming to AWWA C906, or approved equivalent.
- B. Water Service Line (pipe size 3 inches and smaller)
 - 1. Copper (Cu): Provide Type K soft or hard copper pipe conforming to ASTM B88.

2. High Density Polyethylene Pipe (HDPE): PE4710, Pressure Class 200, DR 9 conforming to AWWA C901. J-M Manufacturing PIPE or approved equivalent.

C. Recycled/Reclaimed Water piping shall be purple.

2.2 FITTINGS, GASKETS, COUPLINGS, SLEEVES, AND ASSEMBLY BOLTS AND NUTS

- A. For DIP: Provide fittings with pressure rating greater than or equal to that of the pipe. Provide flanged joints, mechanical joints, push-on joints, and insulating joints where indicated. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated. Provide ends of pipe and fittings suitable for the specified joints. Fittings shall have cement-mortar lining conforming to AWWA/ANSI C104/A21.4.
1. Flanged Joints: Provide bolts, nuts, and gaskets in conformance with AWWA/ANSI C115/A21.15. Flanged fittings shall conform to AWWA/ANSI C110/A21.10 or C153/A21.53.
 - a. Provide flange for set screwed flanges of ductile iron, ASTM A536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250.
 - b. Provide setscrews for set screwed flanges of 190,000 psi tensile strength, heat treated and zinc-coated steel.
 - c. Gaskets for set screwed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA/ANSI C111/A21.11.
 - d. Design of set screwed gaskets shall provide for confinement and compression of gasket when joint to adjoining flange is made.
 - e. Unless otherwise required, above ground flange assembly bolts shall be standard hex-head, cadmium plated machine bolts with American Standard Heavy, hot-pressed, cadmium plated hexagonal nuts. Buried flange nuts and bolts shall be as above except they shall be of Type 304 stainless steel.
 2. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA/ANSI C111/A21.11.
 3. Push-on Joints: Provide shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly conforming to AWWA/ANSI C111/A21.11. Modify bell design fittings, as approved.
 4. Insulating Joints: Provide a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact at the joint between adjacent sections of dissimilar metals.
 - a. Provide joint of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers.
 - b. Provide gasket of the dielectric type, full face, as recommended in AWWA/ANSI C115/A21.15.
 - c. Provide bolts and nuts as recommended in AWWA/ANSI C115/A21.15.
 - d. Fittings shall be epoxy lined and coated with a thickness not less than 6-mils.
- B. For PVC: Fittings shall be DIP or PVC.
1. DIP fittings: Provide gray-iron or ductile-iron conforming to AWWA/ANSI C110/A21.10, with cement-mortar lining conforming to AWWA/ANSI C104/A21.4, and standard thickness, with equivalent cast-iron pipe O.D.
 - a. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except the bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe.
 - b. Provide push-on joints, compression joints and mechanical joints where indicated between pipe and fittings, valves, and other accessories.
 - c. Mechanical joints, glands, bolts and nuts, and gaskets shall conform to AWWA/ANSI C111/A21.11.
 - d. Fittings shall be epoxy lined and coated with a thickness not less than 6-mils.

2. PVC fittings: Provide fabricated PVC fittings for pressure pipe conforming to AWWA C900, C905, or C907.
 - a. PVC fittings shall conform to ASTM D2466.
 - b. Push-on joints shall conform to ASTM D3139.
 - c. Compression joints shall conform to ASTM D3139.
 - d. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets shall conform to ASTM F477.
- C. For PE: Fittings shall conform to AWWA C901 or AWWA C906. Driscopipe, or approved equivalent.
 1. Socket type fittings shall conform to ASTM D2683.
 2. Butt fusion fittings shall conform to ASTM D3261.
 3. Electrofusion fittings shall comply with ASTM F1055.
- D. For Cu:
 1. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18.
 2. Wrought copper solder-joint pressure fittings or wrought copper alloy unions shall conform to ASME B16.22
 3. Cast copper alloy flare fittings shall conform to ASME B16.26.
 4. Wrought copper alloy body, hexagonal stock, metal-to-metal seating surfaces, and solder-joint threaded ends shall conform to ASME B1.20.1.
 5. Compression connections shall be Mueller 110, Ford or approved equivalent.
- E. For HDPE:
 1. Cast Copper Fittings shall conform to ASME B16.18.
 2. Cast Copper Compression Fittings and connections shall be Mueller 110 Ford or approved equivalent.
 3. HDPE Fittings shall conform to PE4710, Pressure Class 200, DR 9 conforming to AWWA C901. Wolseley Industrial Group or approved equivalent.

2.3 GATE VALVES AND BALL VALVES

- A. Gate Valves: Valves shall open by counterclockwise rotation of the valve stem. Provide valves with ends as appropriate for the adjoining pipe.
 1. Stuffing boxes shall have O-ring stem seals. Provide stuffing boxes bolted and constructed so as to permit easy removal of parts for repair.
 2. Valves (2-1/2 inches and larger):
 - a. Provide valves conforming to AWWA C500 or AWWA C509 and of one manufacturer. Valves shall have a non-rising stem, a 2-inch square nut, and double-disc gates. Valves shall be rated for 250 psi maximum working pressure. Mueller 2360 series, ACIPCO, or approved equivalent.
 - b. For the domestic water system, valves shall also conform to ANSI/NSF 61.
 - c. For the fire water system, valves 2 inches through 16 inches in size shall also conform to UL 262 and FM 1120 or FM 1130 to a working pressure of 200 psi.
 3. Where a post indicator is shown, provide valve with an indicator post flange.
- B. Ball Valves: Valves shall open by counterclockwise rotation of the valve stem. Provide valves with ends as appropriate for the adjoining pipe.
 1. Valves (2-inches and smaller):
 - a. Provide valves conforming to AWWA C800 and of one manufacturer. Mueller 300 Series, Ford, or approved equivalent.
 2. Provide valve with operating nut or handle as shown on the Construction Documents.

2.4 BLOW-OFF VALVES, AIR RELEASE AND VACUUM VALVES, AND COMBINATION AIR VALVES

- A. Blow-off valves: Provide valve and service size as shown in the Contract Documents. Provide 2-inch valves at low points of the piping system, and 4-inch valves at dead-ends of the piping system, unless otherwise directed by the Engineer.
 - 1. 2-inch blow-off shall have a 2-inch vertical female iron pipe (FIP) inlet and a 2-inch normal pressure and temperature (NPT) nozzle outlet with cap. Valve shall open by counterclockwise rotation of a top-mounted 9/16-inch square operating nut. All working parts shall be serviceable without excavation. Kupferle/Truflo Model TF550, or approved equivalent.
 - 2. 4-inch blow-off shall have a 4-inch vertical FIP inlet and a 4-inch male iron pipe (MIP) outlet with cap. Valve shall open by counterclockwise rotation of a top-mounted 9/16-inch square operating nut. All working parts shall be serviceable without excavation. Kupferle/Truflo Model TF800, or approved equivalent.
- B. Air release and vacuum valves: Provide valve and service size as shown on the Contract Documents, and where there is an increase in the downward slope or a decrease in the upward slope of the piping system. Valve shall have cast-iron single valve body, and shall conform to AWWA C512. A compound lever system shall have a maximum operating pressure of 300psi. Provide a protective cap for the outlet of the valve. Provide universal air-vacuum type valves, Crispin Model UL, Apco, or approved equivalent.
- C. Combination air valves: Provide valve and service size as shown on the Contract Documents, and at high points and sharp changes in gradient of the pipe system. Valve shall have cast-iron single valve or double valve body, and shall conform to AWWA C512. A simple or compound lever system shall have a maximum operating pressure of 300psi. Provide a protective cap for the outlet of the valve. Crispin Model C, Apco, or approved equivalent.

2.5 CHECK VALVES

- A. Valves: Valves shall have clear port opening and a cast-iron body. Provide spring-loaded or weight-loaded valves where indicated on the Construction Documents.
 - 1. For the domestic water system, provide swing-check type valves conforming to AWWA C508. Provide valves of one manufacturer. Mueller, Apco, or approved equivalent.
 - 2. For the fire water system, provide swing-check type valves conforming to FM 1210 and UL 312. Mueller, Watts, or approved equivalent.

2.6 PRESSURE REDUCING VALVES

- A. Pressure Reducing Valves: Valves shall have a cast-iron body, conforming to ASTM A536, with epoxy interior coating conforming to AWWA, and rated to Pressure Class 300. Cla-Val Model 90-01, Singer, or approved equivalent.
 - 1. Valves shall have flanged ends.
 - 2. Valves sized 3-inches or smaller may have screwed ends.

2.7 POST INDICATORS

- A. Posts Indicators shall withstand up to 900 ft-lbs of operating torque, be free-standing, and tamper-proof.
- B. Post Indicators shall conform to UL 789 and FM 1110. Mueller, ACIPCO, or approved equivalent.
- C. Post indicators on recycled/reclaimed systems shall be painted purple.

2.8 VALVE BOXES, METER BOXES, FRAMES AND COVERS

- A. Water Valve Box: Provide pre-cast concrete valve box for each buried valve. Provide box with steel or cast iron traffic cover marked "WATER." Christy Model G5 with G5C cover or approved equivalent.
- B. Valve or Meter Boxes: Contractor shall verify box size required for water system appurtenances as shown in the Contract Documents. Provide a precast concrete utility box for each buried appurtenance. Provide a traffic-rated lid for H2O loading. A non-traffic rated lid may be used for boxes located in landscape areas. Christy, or approved equivalent.
- C. Valve boxes, meter boxes, frames and covers on recycled/reclaimed systems shall be purple.

2.9 BACKFLOW PREVENTERS

- A. Provide backflow preventers as shown on the Contract Documents. Subject to local water department approval. Backflow preventers on the fire water system shall be subject to approval by the local office of the Fire Marshal.
- B. Reduced Pressure Principle Assemblies (RPPA): Provide a cast-iron body RPPA consisting of two independently operating check valves with a pressure differential relief valve located between the two check valves, two shut-off valves and four test cocks. RPPA shall be tamper-proof and conform to AWWA C511. Febco 860, Watts, or approved equivalent.
- C. Double Check Detector Assemblies (DCDA): Provide a cast-iron body DCDA consisting of mainline double check assemblies in parallel with a bypass double check and meter assembly, two shut-off valves and four test cocks. DCDA shall be tamper-proof and conform to AWWA C510. Febco 806, Watts, or approved equivalent.
- D. Backflow preventers on recycled/reclaimed systems shall be painted purple.

2.10 FIRE DEPARTMENT CONNECTIONS AND WET STAND PIPES

- A. Fire Department Connections (FDC): Provide FDC's with 2-1/2 inch female hose connections, sidewalk or free-standing type. Number of inlets shall be as shown on the Contract Documents. Clapper and spring check inlets shall each have a minimum capacity of 250 gpm, and be furnished with Knox FDC plug. Outlet shall be sized for simultaneous use of all inlets. Connection shall be branded "AUTO SPKR".
 - 1. 2-Way FDC: Connection shall conform to UL 405 or FM 1530. Elkhart, Croker, or approved equivalent.
 - 2. 3-Way FDC: Connection shall be subject to approval by the local water department or fire marshal. Elkhart, Croker, Potter-Roemer or approved equivalent.
 - 3. 4-Way FDC: Connection shall conform to UL 405. Potter-Roemer, Croker, or approved equivalent.
 - 4. 6-Way FDC: Connection shall be subject to approval by the local water department or fire marshal. Croker, Potter-Roemer or approved equivalent.
- B. Wet Stand Pipes (WSP): Provide 2-Way WSP's with valves and two (2) 2-1/2 inch male hose connections free-standing type, with a 4" inlet. Each outlet shall each have a minimum capacity of 250 gpm, and be furnished with a Knox cap. Water to the WSP shall be controlled with a remote valve. Connection shall be branded "HYDRANT." Subject to

approval by the local water department or fire marshal. Croker, Elkhart, Potter-Roemer or approved equivalent.

- C. Fire department connections and wet stand pipes on recycled/reclaimed systems shall be painted purple.

2.11 FDC AND WET STAND PIPE CAPS AND PLUGS

- A. Provide Knox caps or plugs for all new FDC and wet-stand pipes included in the project. Coordinate the number of Knox keys as well as the key signage location with the local Fire Marshal.

2.12 FIRE HYDRANTS

- A. Provide two 2-1/2 inch and one 4-1/2 inch outlets with a 6-inch nominal inside diameter inlet and break-away type bolts. Hydrant shall have a working pressure of 250 psi and shall conform to AWWA C502 or C503, and be UL listed and FM approved. Provide hydrants of one manufacturer. Clow 800 series, Mueller, ACIPCO, or approved equivalent, subject to approval by the local water department and Fire Marshal. Hydrants on recycled/reclaimed systems shall be painted purple.

2.13 THRUST BLOCKS AND PIPE RESTRAINTS

- A. Blocks: Provide thrust blocks in accordance with NFPA 24 Standards. Use concrete conforming to ASTM C94 having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
- B. Pipe Restraints: Provide thrust restraint systems for fittings and joints as required or as indicated on the Plans.
 - 1. For mechanical joint fittings and joints: Pipe restraints shall be "Mega-Lug" pipe restraint system by EBBA Iron, Inc., or approved equivalent.
 - 2. For push-on joint fittings and joints: Pipe restraints shall be "Field-Lok" gaskets by U.S. Pipe, or approved equivalent.
- C. Thrust blocks, gravity blocks, or mechanical pipe restraints may be used at Contractor's option, unless otherwise indicated on the Plans.
- D. Provide thrust blocks or mechanical pipe restraints at all fittings and changes in angle, alignment or elevation.
- E. Where depth or location of water piping, existing utilities, or other structures prohibit the use of standard thrust blocks, gravity blocks or mechanical pipe restraints may be used. Conform to NFPA 24 Standards.

2.14 TAPPING SLEEVES AND TAPPING VALVES

- A. Sleeves shall be epoxy coated and furnished with stainless steel washers, nuts and bolts. Mueller H-615 and H-619, Ford, or approved equivalent.
- B. Tapping valves shall have flanged inlet, Class 125, conforming to ASME B16.1 and furnished with stainless steel washers, nuts and bolts. Tapping valves shall be constructed with a mechanical joint outlet. Mueller T-687, T-642, T-681, or approved equivalent.

2.15 SERVICE SADDLES AND CORPORATION STOPS

- A. Service Saddles: Saddles shall conform to AWWA C800 and NSF 61.
 - 1. For DIP: Provide bronze or stainless steel body, double strap type with a 200 psi maximum working pressure. Mueller BR2 Series, Ford, or approved equivalent.
 - 2. For PVC: Provide bronze body, wide strap type. Mueller H-13000 Series, Ford, or approved equivalent.
 - 3. For PE: Provide stainless steel body, double strap style with a 250 psi maximum working pressure. Ford FSP-323, or approved equivalent.
- B. Corporation Stops: Provide ground key type; bronze conforming to ASTM B61 or ASTM B62, for a working pressure of 100 psi. and suitable for the working pressure of the system.
 - 1. Ends shall be suitable for adjoining pipe and connections, solder-joint, or flared tube compression type joint.
 - 2. Threaded ends shall conform to AWWA C800.
 - 3. Coupling nut for connection to flared copper tubing shall conform to ASME B16.26.
 - 4. Mueller H-15000 Series with "CC" threads and a copper flare straight connection outlet, Ford, or approved equivalent.

2.16 IDENTIFICATION MATERIALS AND DEVICES

- A. Marker Tape: Provide marker tape consisting of metallic foil bonded to plastic film not less than 2-inches wide. Film shall be inert polyethylene plastic. Film and foil shall each not be less than 1-mil. thick. The tape shall be identified with lettering, not less than 3/4-inch high, "CAUTION: WATER MAIN BELOW," repeated at approximately 24-inch intervals.
- B. Tracer Wire for Nonmetallic Piping: Provide 12 gage, coated copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe. Wire shall be tied in at all valves.
- C. Recycled Water identification signage is required according to City of Livermore standards.

2.17 SETTLEMENT JOINTS

- A. Flexible joints shall be used if a differential settlement of greater than 2-inches is anticipated. Flexible joints shall be ductile iron rated, rated for 350 psi working pressure and FM approved. Megalug Flextend or approved equivalent.
- B. Provide pipe restraint on either side of flexible joint to resist thrust forces.

2.18 CORROSION PROTECTION

- A. Encase underground pipe and appurtenances in 4-mil, high-density cross-laminated (HDCL) polyethylene film or 8-mil linear low-density (LLD) polyethylene film in accordance with AWWA/ANSI C105/A21.5. U.S. Pipe, ACIPCO, or approved equivalent.

2.19 CATHODIC PROTECTION

- A. See Section 26 42 00 for cathodic protection requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where water service is being installed.
- B. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 LOCATION OF WATER LINES

- A. Where the location of the water line is not clearly defined by dimensions on the Plans, do not lay water line closer than 10 feet horizontally from any sewer line.
- B. Where water lines cross under gravity sewer lines, encase sewer line in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing.
- C. Where water lines cross sewer force mains and inverted siphons, install water line at least 2 feet above these sewer lines.
- D. When joints in the sewer line are closer than 3 feet horizontally from the water line, encase sewer line joints in concrete.
- E. Do not lay water lines in the same trench with other utilities.
- F. Install water lines at 3'-0" minimum depth or as detailed on Plans.

3.3 INSTALLATION OF PIPING

- A. Inspection:
 - 1. Before placing in position, inspect pipe for noticeable defects. Clean the pipe, fittings, valves, and accessories, and maintain in a clean condition.
 - 2. Remove fins and burrs from pipe and fittings.
- B. Pipe laying and jointing:
 - 1. Provide proper facilities for lowering sections of pipe into trenches.
 - 2. Do not drop or dump pipe, fittings, valves, or any other water line material into trenches.
 - 3. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
 - 4. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of lying.
 - 5. Grade the pipeline in straight lines; avoid the formation of dips and low points.
 - 6. Support pipe at proper elevation and grade.
 - 7. Provide secure firm, uniform support. Wood support blocking will not be permitted.
 - 8. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
 - 9. Provide anchors and supports where indicated and where necessary for fastening work into place.
 - 10. Make proper provision for expansion and contraction of pipelines.
 - 11. Keep trenches free of water until joints have been properly made.
 - 12. Do not lay pipe when conditions of trench or weather prevent proper installation.
 - 13. All fittings shall be blocked with appropriately sized thrust blocks as shown in the Contract Documents.

- C. Installation of Tracer Wire:
 - 1. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe.
 - 2. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- D. Connections to Existing Lines:
 - 1. Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line.
 - 2. Make connections to existing lines under pressure in accordance with the recommended procedures of a manufacturer of pipe of which the line being tapped is made.
- E. The end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads to keep out debris and contamination.

3.4. INSTALLATION OF DUCTILE-IRON PIPING

- A. Install pipe and fittings in accordance with requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.
- B. Jointing:
 - 1. Provide push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.
 - 2. Provide mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and with the recommendations of AWWA C111.
 - 3. Provide flanged joints with the gaskets, bolts, and nuts specified for this type joint.
 - a. Install flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.
 - b. Align bolt holes for each flanged joint.
 - c. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted.
 - d. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without over straining the flange.
 - e. Where flanged pipe and fitting have dimensions that do not allow the installation of a proper flanged joint as specified, replace it by one of proper dimensions.
 - f. Use set screwed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe. Assemble in accordance with the recommendations of the set screwed flange manufacturer.
 - 4. Provide insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints. Bolts for insulating sleeves shall be full size for the bolt holes.
 - 5. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.
- C. Exterior Protection: Completely encase buried ductile iron pipelines and underground appurtenances with polyethylene wrap. Install 8-mil linear low-density polyethylene (LLD) film or 4-mil high-density cross-laminated (HDCL) film per manufacturer's recommendations and in accordance with AWWA/ANSI C105/A21.5 and ASTM A674.
- D. Pipe Anchorage:
 - 1. Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated on the Construction Documents.

2. Pipe anchorage shall be in accordance with NFPA 24 Standards.

3.5 INSTALLATION OF POLYVINYL CHLORIDE PIPING

- A. Install pipe and fittings in accordance with the requirements of UNI B-3 for the following:
 1. The laying of pipe, joining PVC pipe to fittings and accessories.
 2. The setting of hydrants, valves, and fittings.
- B. Comply with the recommendations for pipe joint assembly and appurtenance installation in AWWA Manual M23, Chapter 7, "Installation."
- C. Comply with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111.
- D. Jointing:
 1. Provide push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings.
 2. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel.
 3. For push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint.
 4. Use an approved lubricant recommended by the pipe manufacturer for push-on joints.
 5. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UNI B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly.
 6. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint. Cut off spigot end of pipe for compression-type joint or mechanical-joint connections and do not re-bevel.
 7. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.
- E. Pipe Anchorage:
 1. Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated on the Construction Documents.
 2. Anchorage shall be in accordance with the requirements of UNI B-3 and in accordance with NFPA 24 Standards for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated on the Construction Documents.

3.6 INSTALLATION OF POLYETHYLENE PIPING

- A. Install pipe, fittings, and appurtenances in accordance with PPI and Manufacturer's Recommendations.
- B. Jointing:
 1. Provide mechanical joints, compression fittings, or flanges as recommended by the manufacturer.
 2. Jointing shall be performed using proper equipment and machinery by trained and certified personnel.
 3. Joints, fittings and tools shall be clean and free of burrs, oil, and dirt.
 4. Butt fusion:
 - a. Pipe ends shall be faced to establish clean, parallel mating surfaces.

- b. Align and securely fasten the components to be joined squarely between the jaws of the joining machine.
 - c. Heat the ends of the pipe to the pipe manufacturer's recommended temperature interface pressure and time duration. A pyrometer or other surface temperature measuring device should be used to insure proper temperature of the heating tool. Temperature indicating crayons shall not be used on a surface which will come into contact with the pipe or fitting.
 - d. Prevent molten plastic from sticking to the heater faces. Molten plastic on the heater faces shall be removed immediately according to the tool manufacturer's instructions.
 - e. Bring the molten ends together with sufficient pressure to properly mix the pipe materials and form a homogeneous joint. Hold the molten joint under pressure until cooled adequately to develop strength. Refer to the Manufacturer's recommendations for temperature, pressure, holding, and cooling times.
 - f. Remove the inside bead from the fusion process using Manufacturer's recommended procedure.
5. Socket fusion:
- a. Mixing manufacturers' heating tools and depth gages will not be allowed unless the tools conform to ASTM F1056.
 - b. Pipe ends shall be faced square to establish clean, parallel mating surfaces.
 - c. Clamp the cold ring on the pipe at the proper position using a depth gauge.
 - d. Heat the tool to the pipe manufacturer's recommended temperature. A pyrometer or other surface temperature measuring device should be used to insure proper temperature. Temperature indicating crayons shall not be used on a surface which will come into contact with the pipe or fitting.
 - e. Follow manufacturer's recommendations for bringing the hot tool faces into contact with the outside surface of the end of the pipe and the inside surface of the socket fitting.
 - f. Simultaneously remove the pipe and fitting from the tool.
 - g. Inspect the melt pattern for uniformity and immediately insert the pipe squarely and fully into the socket of the fitting until the fitting contacts the cold ring. Do not twist the pipe or fitting during or after the insertion.
 - h. Hold or block the pipe in place during cooling.
6. Electrofusion:
- a. Unless the operation is for a saddle-type electrofusion joint, pipe ends shall be faced square to establish clean, parallel mating surfaces.
 - b. Clamp the pipe and fitting at the proper position in the fixture.
 - c. Connect the electrofusion control box to the fitting and to the power source. Apply the electric current using manufacturer's instructions.
 - d. Allow the joint to cool before removing the clamping fixtures.

3.7 INSTALLATION OF VALVES

- A. Install gate valves conforming to AWWA C500 and UL 262 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix (Installation, operation, and Maintenance of Gate Valves) to AWWA C509.
- B. Install gate valves conforming to AWWA C509 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix (Installation, Operation, and Maintenance of Gate Valves) to AWWA C509.

- C. Install gate valves on PVC water mains in addition in accordance with the recommendations for appurtenance installation in AWWA Manual M23, Chapter 7, "Installation."
- D. Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated.
- E. Provide and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

3.8 INSTALLATION OF VALVE AND METER BOXES

- A. Boxes shall be centered over the appurtenance so as not to transmit shock or stress. Covers shall be set flush with the surface of the finished pavement, or as shown in the Construction Documents. Backfill shall be placed around the boxes and compacted to the specified level in a manner that will not damage or displace the box from proper alignment or grade. Misaligned boxes shall be excavated, plumbed, and backfilled at no additional cost to the [District/Owner].

3.9 INSTALLATION OF HYDRANTS

- A. Install hydrants, except for metal harness, plumbed vertical, in accordance with AWWA C600 for hydrant installation and as indicated.
- B. Provide and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Hydrants shall be set so that mounting bolts clear the top of finished grade by three inches so bolts may be easily replaced if needed.
- C. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached.

3.10 SERVICE LINE CONNECTIONS TO WATER MAINS

- A. Connect service lines of size shown on plans to the main with a rigid connection or a corporation stop and gooseneck. Install a gate valve on the service line.
- B. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.
- C. Connect service lines to PVC plastic water mains in accordance with UNI-B-8 and the recommendations of AWWA Manual M231, Chapter 9, "Service Connections."

3.11 INSTALLATION OF BACKFLOW PREVENTERS

- A. Devices shall be installed horizontal and level, with three feet minimum clearances from obstructions.
- B. Bottom of backflow device shall be 12-24" above grade.

3.12 WATER TANKS

- A. Install water tanks per Manufacturer's recommendations in conformance with AWWA D103.

3.14 HYDROSTATIC PIPELINE TESTING

- A. Requirements:
1. After the pipe has been laid and backfilled, perform hydrostatic pressure tests.
 2. Do not conduct tests until at least 12 hours have elapsed since pipe lying and at least 5 days have elapsed since placing of concrete thrust blocks.
 3. Fill the pipe with water which shall remain without external application of pressure for 24 hours before tests are conducted.
 4. Prior to hydrostatic testing, flush pipe system with fresh water until piping is free of dirt and foreign matter.
 5. Apply pressure by a pump and measured by a test gage. All necessary apparatus and labor for conducting the pressure and leakage tests shall be furnished by the Contractor.
 6. Ensure the release of air from the line during filling, and prevent collapse due to vacuum when dewatering the line.
 7. For pressure test, use a hydrostatic pressure not less than 200 psi for fire water or combined water systems and 1 ½ times operating pressure for domestic water systems. The duration of the test shall not be less than 4 hours with the variation in pressure of not more than 5 psi for the duration of the test.

- B. Leakage Tests:
1. At Contractor's option, leakage tests can be performed at the same time as hydrostatic pressure tests.
 2. Leakage rate shall be measured for at least 4 hours with a certified water meter, or other approved method. If requested, meter certification shall be submitted to the [District/Owner] for approval prior to testing.
 3. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
 4. Leakage at mechanical couplings and joints, tapping sleeves, saddles, flanged joints, and copper piping will not be accepted. Correct any visible leaks.
 5. Push-on joints: Test ductile iron pipe for leakage in accordance with AWWA C600 as shown in the following table:

TABLE 1
Allowable Leakage per 1000 feet of DIP Pipeline (Gal/Hr)

Average Test Pressure	Nominal Pipe Diameter - Inches									
	3	4	6	8	10	12	14	16	18	20
(psi)										
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37

Average Test Pressure	Nominal Pipe Diameter - Inches									
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12

6. When the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.
7. Test polyvinyl chloride pipe for leakage in accordance with the recommendations of the Uni-Bell Plastic Pipe Association (UNI) as shown in the following table:

TABLE 2

Allowable Leakage per 1000 feet or 50 joints of PVC Pipeline (Gal/Hr)

Nominal Pipe Size (inches)	Average Test Pressure in Line (psi.)	
	200	250
4	0.38	0.43
6	0.57	0.64
8	0.76	0.85
10	0.96	1.07
12	1.15	1.28
14	1.34	1.50
16	1.53	1.71
18	1.72	1.92
20	1.91	2.14

8. Should any section of new pipe fail to pass either test, locate and repair the defective pipe and repeat the test.

3.15 STERILIZATION AND FLUSHING

A. General:

1. Domestic water lines, mains, and branches by chlorination in accordance with AWWA C601 and as herein specified.

B. Sterilization Methods:

1. Liquid Chlorine Solution Method:

- a. Flush all foreign matter from mains, branch runs, hydrant runs, and installed services.
- b. Introduce liquid chlorine solution at appropriate locations to assure uniform distribution through the facilities at the proper concentration.
- c. Do not use installed copper service lines to convey the concentrated chlorine solution to the mains.
- d. The sanitizing solution shall be retained in the facilities for a period of 24 hours after which each service, hydrant run, branch run and dead end shall be flushed until:
 - i. Residual chlorine is less than 1 part per million.
 - ii. Residual chlorine is no greater than the concentration of chlorine in the water supplied for flushing.
- e. Chlorine shall be a 1 percent solution (containing 10,000 parts per million available chlorine) or shall be obtained by use of dry chlorine in tablet form firmly attached to inside tope of the pipe.
- f. The required concentration of chlorine in the pipe is 50 parts per million. This concentration may be attained by adding 5 gallons of the chlorine solution to 1,000 gallons of water.
- g. The weight of chlorine or chlorine compound required to make a 1 percent chlorine solution is as follows:

TABLE 3
One-Percent Chlorine Solution Mix

AMOUNT OF PRODUCT COMPOUND		QUANTITY OF WATER (in gallons)
High-Test Calcium Hypochlorite (65-70% Cl)	1 pound	7.50
Chlorinated Lime (32-35% Cl)	2 pounds	7.50
Liquid Laundry Bleach (5.25% Cl)	1 gallon	4.25
Liquid Chlorine (100% available chlorine)	0.62 pounds	7.50

2. HTH Tablet Method:

- a. The required concentration of chlorine in the mains may be obtained by the use of HTH tablets as produced by Olin Mathieson in the following quantities or approved equivalent:

TABLE 4
 HTH Tablet (70%) Dosage
 Number of Tablets Per Length of Pipe

Length of Section	DIAMETER OF PIPE				
	4 inches	6 inches	8 inches	10 inches	12 inches
13 feet	1	2	3	4	6
18 feet	1	2	3	5	6
20 feet	1	2	3	5	7
30 feet	2	3	5	7	10
36 feet	2	3	5	8	12
40 feet	2	4	6	9	14
100 feet	4	9	15	23	30

- b. Tablets are to be fastened to the inside top surface of each length of pipe using "Permatex No. 1" no earlier than the day pipe is laid.
- c. Tablets shall not be installed in the pipe and left overnight before laying and shall not be accessible at any time for casual pilferage by the general public or by children. Tablets shall be stored in a hermetically sealed container.
- d. The new water lines are to be slowly filled with water. Air is to be exhausted from each dead end, branch run, hydrant run, and installed service.
- e. Water shall be retained for a period of 24 hours, after which each service, hydrant run, branch run and dead end shall be thoroughly flushed to clear foreign matter and until:
 - i. Residual chlorine concentration is less than 1 part per million
 - ii. Residual chlorine is no greater than the concentration of chlorine in the water supplied for flushing.

C. Bacteriological Testing:

- 1. Samples shall be gathered and tests conducted at the expense of the Contractor by a laboratory certified by the California Department of Health Services as an Environmental Testing Laboratory (ELAP).
- 2. Samples are to be taken at representative points as required by the [District/Owner] and authorities having jurisdiction.
- 3. The new water lines shall remain isolated and out of service until satisfactory test results have been obtained that:
 - a. Meet the requirements of the California Department of Health Services, Drinking Water Standards.
 - b. [District/Owner] has accepted the results as indicative of the bacteriological condition of the facilities.
 - c. If unsatisfactory or doubtful results are obtained from the initial sampling, repeat the chlorination process until acceptable test results are reported.

3.16 HYDRANT FLOW TESTING

- A. After completion of the pipe and hydrant installation and service connections, the new hydrants shall be flow tested and results provided to the District's Representative and Engineer. The Contract shall provide the following information:
1. Who performed the test.
 2. Testing date.
 3. Hydrant location.
 4. Static pressure (psig).
 5. Residual pressure (psig).
 6. Flow (gpm).
 7. Orifice size (in).

END OF SECTION

SECTION 33 3000

SANITARY SEWER

PART 1 – GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to on-site sanitary sewerage excluding portions within five feet of buildings unless otherwise noted. Any work within the public right-of-way shall be constructed to the standards of the City of Livermore.
 - 1. Sanitary Sewer System, including piping and structures.
- B. Contractor shall provide all labor, equipment, and materials, unless otherwise noted.
- C. Related Sections:
 - 1. Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING.
 - 2. Section 03 3000 – CAST-IN-PLACE CONCRETE.

1.2 SUBMITTALS

- A. Comply with the requirements of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Product Data: Manufacturer's literature and data, including, where applicable, pressure rating, capacity, labels, or other markings on equipment made to the specified standards for materials, for the following:
 - 1. Piping and fittings.
 - 2. Jointing material.
 - 3. Gaskets, couplings, and sleeves.
 - 4. Precast concrete structures, including manholes.
 - 5. Concrete mix design for sanitary structures.
 - 6. Manhole lids and frames.
 - 7. Steps.
 - 8. Clean-out boxes.
 - 9. Backwater valves.
 - 10. Grease interceptor
 - 11. Vent piping and screen

1.3 QUALITY ASSURANCE

- A. Comply with the latest editions of the following Standards and Regulations:
 - 1. American Concrete Pipe Association (ACPA).
 - a. ACPA 01-102 Concrete Pipe Handbook.
 - b. ACPA 01-103 Concrete Pipe Installation Manual.
 - 2. American National Standards Institute (ANSI).
 - a. ANSI B18.5.2.1M Metric Round Head Short Square Neck Bolts.
 - 3. American Railway Engineering & Maintenance-of-Way Association (AREMA).
 - a. AREMA 1-5 Pipelines.
 - 4. American Society for Testing and Materials (ASTM).
 - a. A 123/A 123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A 307 Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - c. A 47 Ferritic Malleable Iron Castings.**
 - d. A 47M Ferritic Malleable Iron Castings (Metric). **

- e. A 48 Gray Iron Castings. **
- f. A 48M Gray Iron Castings (Metric). **
- g. A 536 Ductile Iron Castings.
- h. A 563 Carbon and Alloy Steel Nuts.
- i. A 563M Carbon and Alloy Steel Nuts (Metric).
- j. A 74 Cast Iron Soil Pipe and Fittings.
- k. A 746 Ductile Iron Gravity Sewer Pipe.
- l. C 12 Installing Vitrified Clay Pipe Lines.
- m. C 14 Concrete Sewer, Storm Drain, and Culvert Pipe.
- n. C 14M Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
- o. C 150 Portland Cement.
- p. C 260 Air-Entraining Admixtures for Concrete.
- q. C 270 Mortar for Unit Masonry.
- r. C 301 Vitrified Clay Pipe.
- s. C 33 Concrete Aggregates.
- t. C 361 Reinforced Concrete Low-Head Pressure Pipe.
- u. C 361M Reinforced Concrete Low-Head Pressure (Metric).
- v. C 425 Compression Joints for Vitrified Clay Pipe and Fittings.
- w. C 443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- x. C 443M Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
- y. C 478 Precast Reinforced Concrete Manhole Sections.
- z. C 478M Precast Reinforced Concrete Manhole Sections (Metric).
- aa. C 494 Chemical Admixtures for Concrete.
- bb. C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- cc. C 700 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
- dd. C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- ee. C 76M Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).
- ff. C 828 Low-Pressure Air Test of Vitrified Clay Pipe Lines.
- gg. C 920 Elastomeric Joint Sealants.
- hh. C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- ii. C 923M Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric).
- jj. C 924 Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- kk. C 924M Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric).
- ll. C 94 Ready-Mixed Concrete. **
- mm. C 94/C 94M Ready-Mixed Concrete.
- nn. C 969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
- oo. C 969M Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).
- pp. C 972 Compression-Recovery of Tape Sealant.
- qq. C 990 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers.
- rr. C 990M Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric).
- ss. D 1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- tt. D 1785 Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.

- uu. D 2235 Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - vv. D 2241 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - ww. D 2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - xx. D 2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - yy. D 2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - zz. D 2466 Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40.
 - aaa. D 2467 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - bbb. D 2680 Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
 - ccc. D 2751 Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
 - ddd. D 2996 Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 - eee. D 2997 Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 - fff. D 3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - ggg. D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - hhh. D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - iii. D 3262 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
 - jjj. D 3350 Polyethylene Plastics Pipe and Fittings Materials.
 - kkk. D 3753 Glass-Fiber-Reinforced Manholes.
 - lll. D 3840 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Non-pressure Applications.
 - mmm. D 4101 Propylene Injection and Extrusion Materials.
 - nnn. D 412 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.
 - ooo. D 4161 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
 - ppp. D 624 Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - qqq. F 1336 Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
 - rrr. F 402 Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
 - sss. F 405 Corrugated Polyethylene (PE) Tubing and Fittings.
 - ttt. F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - uuu. F 714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - vvv. F 758 Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.
 - www. F 794 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - xxx. F 894 Polyethylene (PE) Large Diameter
 - yyy. Profile Wall Sewer and Drain Pipe.
 - zzz. F 949 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
5. ASME International (ASME).
 - a. B1.20.1 Pipe Threads, General Purpose, Inch.
 - b. B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
 - c. B18.2.2 Square and Hex Nuts.
 - d. B18.5.2.2M Metric Round Head Square Neck Bolts.
 6. American Water Works Association (AWWA).

- a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. C105 Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. C110 Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water.
 - d. C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. C115 Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
 - f. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - g. C153 Ductile-Iron Compact Fittings for Water Service.
 - h. C302 Reinforced Concrete Pressure Pipe, Noncylinder Type.
 - i. C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - j. C606 Grooved and Shouldered Joints.
 - k. C900 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution.
 - l. M23 Manual: PVC Pipe - Design and Installation.
 - m. M9 Manual: Concrete Pressure Pipe.
7. California Department of Transportation (Caltrans): Standard Specifications:
 - a. Section 55: Steel Structures
 - b. Section 70: Miscellaneous Drainage Facilities
 - c. Section 75: Miscellaneous Metal
 8. Cast Iron Soil Pipe Institute (CISPI).
 - a. 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. 310 Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 9. Uni-Bell PVC Pipe Association (UBPPA).
 - a. UNI-B-3 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch).
 - b. UNI-B-6 Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe.
 10. City of Livermore Standard Plans and Specifications.
 11. American Association of State Highway and Transportation Officials (AASHTO) for H2O Loading.
 12. American Concrete Institute (ACI).
 13. Other authorities having jurisdiction.
- B. System Description: Grades and elevations are to be established with reference to the benchmarks referenced on the Drawings.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Delivery and Storage
1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
 2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
- B. Handling
1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special

care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 – PRODUCTS

2.1 PIPING

- A. Polyvinyl Chloride (PVC) Pipe: PVC pipe and fittings conforming to ASTM D3034, SDR 26 with bell-and-spigot type of rubber gasket joints. Bells shall be integral with pipe. Spigot end pipe with separate double hub couplings is not acceptable.
- B. Vitrified Clay Pipe (VCP): VCP and fitting shall conform to ASTM C700, Extra Strength.
- C. Polyethylene Pipe (PE): PE 4710, Pressure Class, DR 11, conforming to AWWA C906. Driscoflex 4000/4100, or approved equivalent.
 - 1. Fittings shall conform to AWWA C901 or AWWA C906. Driscopipe, or approved equivalent.
 - a. Socket type fittings shall conform to ASTM D2683.
 - b. Butt fusion fittings shall conform to ASTM D3261.
 - c. Electrofusion fittings shall comply with ASTM F1055.

2.2 MANHOLES

- A. Manholes shall be pre-cast concrete of the size and shape shown on the Drawings and shall conform to Sections 70-4.02 of the Caltrans Standard Specifications and to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor's option. Concrete shall consist of Type II cement
- B. Frames and covers shall be cast iron conforming to Section 55-2.03 and 75-1.02 of the Caltrans Standard Specifications. Manhole covers shall have the words "SANITARY SEWER" in letters not less than 2 inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.
- C. All interior concrete surfaces shall be coated with Xypex Concentrate or approved equivalent. Use of a water-resistant admix such as "Xypex Crystalline" is acceptable, at contractor option.
- D. Frames and lids for manholes shall be match-marked in pairs before delivery to the job site. The lids shall fit into their frames without rocking.
- E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Drawings. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.
- F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall be conforming to the requirements of Caltrans Section 90 and as herein specified. The concrete shall be Class 2. The grading of the combined aggregate shall conform with the Caltrans requirements of the 1/2-inch maximum. The consistency of the fresh aggregate shall be such that the slump does not exceed four inches, as determined by Test Method No. Calif. 520. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.

2.3 PIPE TO STRUCTURE CONNECTOR/SEAL

- A. A flexible pipe to manhole connector shall be used for all pipe penetrations and/or cast-in-place concrete structures.
 - 1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.
 - 2. The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C-923. The connector and stainless steel hardware shall meet or exceed the performance requirements proscribed in ASTM C-923.
 - 3. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.
 - 4. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

2.4 CLEAN-OUTS

- A. A box shall be provided for each clean-out. Boxes shall be pre-cast concrete with cast iron frame and cover marked "SAN SEWER"; Christy G05 or approved equivalent.

2.5 BACKWATER VALVES

- A. Backwater valves shall be Josam Series 67500, or approved equivalent.

2.6 SETTLEMENT JOINTS

- A. Flexible joints shall be used if a differential settlement of greater than 2-inches is anticipated. Flexible joints shall be ductile iron rated, rated for 350 psi working pressure and FM approved. Megalug Flextend or approved equivalent.
- B. Provide pipe restraint on either side of flexible joint to resist thrust forces.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION

- A. Pipe shall be installed in conformance with Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING, and manufacturer's recommendations.
- B. Pipe laying:
 - 1. No pipe shall be laid until the Geotechnical Engineer inspects and approves the conditions of the bottom of the trench.
 - 2. Pipe laying shall proceed "up grade" with the spigot section of the bell-and-spigot pipe pointing in the direction of the flow.
 - 3. Each section of pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.
 - 4. Pipe shall not be laid when the condition of the trench or the weather is unsuitable.
- C. Debris Control:

1. The interior of the sewer pipe shall be kept clean of dirt and debris at all times. When work is not in progress, open ends of pipe and fittings shall be plugged.
2. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past every joint immediately after joining has been completed.

3.2 POURED-IN-PLACE CONCRETE

- A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of the Caltrans Standard Specifications.
- B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the Caltrans Standard Specifications. Unless otherwise noted herein or in the Drawings, exposed surfaces of structures shall be Class 1 surface finish.
- C. Curing shall conform to applicable portions in Section 90 of Caltrans Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the District Representative has approved the forms and reinforcement.
- D. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

3.3 PIPELINE AIR TESTING AND FLUSHING

- A. All new sections of sanitary sewer shall be tested using the following procedures:
 1. Test is conducted between two consecutive manholes, or as directed by the District's Representative.
 2. The test section of the sewer shall be plugged at each end. One of the plugs used at the manhole shall be tapped and equipped for the air inlet connection for filling the line from an air compressor.
 3. All service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowout.
 4. Connect air hose to tapped plug selected for the air inlet. Connect the other end of the air hose to the portable air control equipment, which consists of valves and pressure gauges used to control the air entry rate into the sewer test section, and to monitor the air pressure in the pipeline. More specifically, the air control equipment includes a shut-off valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0-5 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of 0.40 psi.
 5. Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set-up. Test operations may commence.
 6. Supply air to the test section slowly, filling the pipeline until a constant pressure of 3.5 psig is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig.
 7. When constant pressure of 3.5 psig is reached, throttle the air supply to maintain the internal pressure above 3.0 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections. If leakage is detected at any cap plug, release the pressure in the line and tighten all leaky caps and plugs. Start the test operation again by supplying air. When it is necessary to

bleed off the air to tighten or repair a faulty plug, a new 5-minute interval must be allowed after the pipeline has been refilled.

8. After the stabilization period, adjust the air pressure to 3.5 psig and shut-off or disconnect the air supply. Observe the gauge until the air pressure reached 3.0 psig. At 3.0 psig, commence timing with a stopwatch until the pressure drops to 2.5 psig, at which time the stop watch is stopped. The time required, as shown on the stopwatch, for a pressure loss of 0.5 psig is used to compute the air loss.
9. If the time, in minutes and seconds, for the air pressure drop from 3.0 to 2.5 psi is greater than that shown in the following table for the designated pipe size, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued at any time.
10. If the time, in minutes and seconds, for the 0.5 psig drop is less than that shown in the following table for the designated pipe size, the section of the pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

Requirements for Air Testing

Pipe Size (in inches)	Time	
	Minutes	Seconds
4	2	32
6	3	50
8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	30

(For larger diameter pipe use the following: Minimum time in seconds = 462 X pipe diameter in feet).

11. For 8 inch and smaller pipe, only: if, during the 5 minute saturation period, pressure drops less than 0.5 psig after the initial pressurization and air is not added, the pipe section undergoing test shall have passed.
12. Multi-pipe sizes: when the sewer line undergoing test is 8 inch or larger diameter pipe and includes 4 inch or 6 inch laterals, the figures in the table for uniform sewer main sizes will not give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo the air test, the State's representative can compute the "average" size in inches which is then multiplied by 38.2 seconds. The results will give the minimum time in seconds acceptable for a pressure drop of 0.5 psig for the "averaged" diameter pipe.
13. Adjustment Required for Groundwater:
 - a. An air pressure correction is required when the ground water table is above the sewer line being tested. Under this condition, the air test pressure must be increased .433 psi for each foot the ground water level is above the invert of the pipe.
 - b. Where ground water is encountered or is anticipated to be above the sewer pipe before the air testing will be conducted, the following procedure shall be implemented at the time the sewer main and manholes are constructed.
 - i. Install a ½ inch diameter pipe nipple (threaded one or both ends, approximately 10 inch long) through the manhole wall directly on top of one of the sewer pipes entering the manhole with threaded end of nipple extending inside the manhole.
 - ii. Seal pipe nipple with a threaded 1/2 inch cap.
 - iii. Immediately before air testing, determine the ground water level by removing the threaded cap from the nipple, blowing air

- through the pipe nipple to remove any obstruction, and then connecting a clear plastic tube to the pipe nipple.
- iv. Hold plastic tube vertically permitting water to rise in it to the groundwater level.
 - v. After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.
 - vi. Determine air pressure correction, which must be added to the 3.0 psig normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives the air pressure correction in pounds per square inch to be added.
Example: if the vertical height of water from the sewer invert to the top of the water column measures 11.55 feet, the additional air pressure required would be:
$$\frac{(11.55)}{(2.31)} = 5.0 \text{ psig}$$
Therefore, the starting pressure of the test would be 3.0 plus 5 or 8.0 psig, and the ½ pound drop becomes 7.5 psig. There is no change in the allowable drop (0.5 psig) or in the time requirements established for the basic air test.

3.4 DEFLECTION TESTING & CLEANING

- A. Flush system pipelines, manholes and related structures with water to clean. A metal screen shall be used downstream at the point of connection to the existing system to collect and remove any rock or other debris that is flushed out during cleaning. Reclaimed water shall be used where available.
- B. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.
- C. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.
- D. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.
- E. Pull-Through Device:
 1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.
 - a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.
 - b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.
 2. Ball, cylinder, or circular sections shall conform to the following:
 - a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
 - b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
 - c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

- d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
3. Pull-Through Device:
 - a. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.
 - b. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.
- F. Deflection measuring Device:
 1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.
 2. Obtain approval of deflection measuring device prior to use.
- G. Deflection Measuring Device Procedure:
 1. Measure deflections through each run of installed pipe.
 2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.
 3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.
- H. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.5 VIDEO INSPECTION

- A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the sewer line shall be video inspected with a color closed-circuit television with tilt-head camera recorded in DVD format. Two (2) copies of the inspection DVD and log sheets shall be provided to the [District's/Owner's Representative].
 1. The following observations from video inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:
 - a. Low spot (1/2 inch or greater - mainlines only).
 - b. Joint separations (1/4 inch or greater opening between pipe sections).
 - c. Cocked joints present in straight runs or on the wrong side of pipe curves.
 - d. Chips in pipe ends.
 - e. Cracked or damaged pipe.
 - f. Dropped joints.
 - g. Infiltration.
 - h. Debris or other foreign objects.
 - i. Other obvious deficiencies.
 - j. Irregular condition without logical explanation.

END OF SECTION

SECTION 33 4000

STORM DRAINAGE

PART 1 – GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to on-site storm drainage excluding portions within five feet of buildings unless otherwise noted. Any work within the public right-of-way shall be constructed to the standards of the City of Livermore and State of California Department of Transportation as may be appropriate.
 - 1. Storm drain piping.
 - 2. Storm drain structures including curb inlets, catch basins, area drains, and manholes.
- B. Contractor shall provide all labor, equipment, and materials, unless otherwise noted.
- C. Related Sections:
 - 1. Section 31 2333 – TRENCHING, BACKFILLING, AND COMPACTING.

1.2 SUBMITTALS

- A. Comply with the requirements of Section 01 3300 – SUBMITTAL PROCEDURES.
- B. Product Data: Manufacturer's literature and data, including, where applicable, pressure rating, capacity, labels, or other markings on equipment made to the specified standards for materials, for the following:
 - 1. Piping and fittings.
 - 2. Jointing material.
 - 3. Gaskets, couplings, and sleeves.
 - 4. Precast concrete structures, including manholes and drainage inlets.
 - 5. Concrete mix design for precast and cast-in-place structures.
 - 6. Manhole lids and frames.
 - 7. Manhole steps.
 - 8. Pipe to Structure Connection Seal.
 - 9. Drainage inlet grates and frames.

1.3 QUALITY ASSURANCE

- A. Comply with the latest editions of the following Standards and Regulations:
 - 1. American Society for Testing and Materials (ASTM).
 - a. A74: Cast Iron Soil Pipe and Fittings.
 - b. A615: Deformed and Plain Billet-Steel Bars for Reinforcement.
 - c. B32: Solder Metal.
 - d. C76: Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - e. C150: Portland Cement.
 - f. C478: Precast Reinforced Concrete Manhole Sections.
 - g. C494: Chemical Admixtures for Concrete.
 - h. C920-02: Elastomeric Joint Sealants.
 - i. D2241-00: Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - j. D2680-01 Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - k. D2729: Perforated PVC Drain Pipe.

- l. D3034-00: Type PSM Polyvinyl Chloride (PVC) Sewer pipe and Fittings.
 - m. F1336-02: Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
 - 2. California Department of Transportation (Caltrans): Standard Specifications:
 - a. Section 51: Concrete Structures.
 - b. Section 52: Reinforcement.
 - c. Section 55: Steel Structures.
 - d. Section 66: Corrugated Metal Pipe.
 - e. Section 70: Miscellaneous Facilities.
 - f. Section 72: Slope Protection.
 - g. Section 75: Miscellaneous Metal.
 - h. Section 90: Portland Cement Concrete.
 - 3. American Association of State Highway and Transportation Officials (AASHTO) for H20 Loading.
 - 4. American Concrete Institute (ACI).
 - 5. Other authorities having jurisdiction.
- B. System Description: Grades and elevations are to be established with reference to the benchmarks referenced on the Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

- C. Delivery and Storage
1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
 2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
 3. Cement, Aggregate, and Reinforcement: As specified in Section 03 3000 – CAST-IN-PLACE CONCRETE.
- D. Handling
1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 – PRODUCTS

2.1 PIPING

- A. Polyvinyl Chloride (PVC) Pipe: PVC pipe conforming to ASTM D3034, SDR 26 with bell-and-spigot type of rubber gasket joints. Bells shall be integral with pipe. Spigot end pipe with separate double hub couplings is not acceptable.
- B. Reinforced Concrete Pipe (RCP): RCP shall conform to ASTM C76 with tongue-and-groove or bell-and-spigot joints. Unless indicated otherwise on the plans, all reinforced concrete pipe shall be Class III, 1350-D pipe.
- C. High-Density Polyethylene (HDPE) Pipe: HDPE Pipe shall conform to AASHTO M294 Type S. Acceptable for use in non-vehicular areas ONLY.

- D. Polyethylene Pipe (PE): PE 4710, Pressure Class 160, DR 13.5, conforming to AWWA C906. Driscoplex 4000/4100, or approved equivalent.
- E. Perforated Pipe: PVC conforming to ASTM D2729 or HDPE SDR 17 conforming to AWWA C906

2.2 MANHOLES

- A. Manholes shall be pre-cast concrete of the size and shape shown on the Drawings and shall conform to Sections 70-4.02 of the Caltrans Standard Specifications and to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor's option. Concrete shall consist of Type II cement.
- B. Frames and covers shall be cast iron conforming to Section 75-2.02B of the Caltrans Standard Specifications. Manhole covers shall have the words "STORM DRAIN" in letters not less than 2-inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.
- C. All interior concrete surfaces shall be coated with Xypex Concentrate or approved equivalent. Use of a water-resistant admix such as "Xypex Crystalline" is acceptable, at Contractor's option.
- D. Frames and grates for manholes and catch basins shall be match-marked in pairs before delivery to the job site. Grates shall be ductile iron conforming to Section 75-2.02B of the Caltrans Standard Specifications. The grates shall fit into their frames without rocking. Grates shall have a maximum opening of one-half inch between bars, unless otherwise noted in the Drawings. All drainage inlets shall be marked with a stencil or permanent label reading "NO DUMPING FLOWS TO CREEK."
- E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Drawings. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.
- F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall conform to the requirements of Caltrans Section 90 and as herein specified. The concrete shall be minor concrete. The grading of the combined aggregate shall conform with the Caltrans requirements of the 1/2-inch maximum. The consistency of the fresh aggregate shall be such that the slump does not exceed four inches, as determined by Test Method No. Calif. 520. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.

2.3 PIPE TO STRUCTURE CONNECTOR/SEAL

- A. A flexible pipe to manhole connector shall be used for all pipe penetrations and/or cast-in-place concrete structures.
 - 1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.

2. The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C-923. The connector and stainless steel hardware shall meet or exceed the performance requirements proscribed in ASTM C-923.
3. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.
4. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

2.4 CLEAN-OUTS

- A. A box shall be provided for each clean-out. Boxes shall be pre-cast concrete with cast iron frame and cover marked "STORM DRAIN"; Christy G05 or approved equivalent.

2.5 CULVERT AND OUTFALL HEADWALLS

- A. All headwalls shall be constructed in conformance with Caltrans Standard Plans as indicated.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION

- A. Pipe shall be installed in conformance with Section 31 2333 – TRENCHING, BACKFILLING AND COMPACTING, and manufacturer's recommendations. HDPE pipe shall be installed in conformance with ASTM D2321 and as recommended by the pipe manufacturer. HDPE pipe is acceptable for use in non-vehicular areas ONLY.
- B. Pipe laying:
 1. No pipe shall be laid until the Geotechnical Engineer inspects and approves the conditions of the bottom of the trench.
 2. Pipe laying shall proceed "up grade" with the spigot section of the bell-and-spigot pipe pointing in the direction of the flow.
 3. Each section of pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.
 4. Pipe shall not be laid when the condition of the trench or the weather is unsuitable.
- C. Debris Control:
 1. The interior of the sewer pipe shall be kept clean of dirt and debris at all times. When work is not in progress, open ends of pipe and fittings shall be plugged.
 2. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past every joint immediately after joining has been completed.

3.2 POURED-IN-PLACE CONCRETE

- A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of the Caltrans Standard Specifications.
- B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the Caltrans Standards Specifications. Unless otherwise noted herein or in the Drawings, exposed surfaces of structures shall be Class 1 surface finish.

- C. Curing shall conform to applicable portions in Section 90 of Caltrans Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the District Representative has approved the forms and reinforcement.
- D. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

3.3 PIPELINE FLUSHING

- A. Newly constructed storm drain pipes shall be flushed with water to clean. A metal screen shall be used to collect and remove any rock, silt and other debris that is flushed out during cleaning. Reclaimed water shall be used where available.

3.4 DEFLECTION TESTING

- A. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.
- B. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.
- C. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.
- D. Pull-Through Device:
 - 1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.
 - a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.
 - b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.
 - 2. Ball, cylinder, or circular sections shall conform to the following:
 - a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
 - b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
 - c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.
 - d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
 - 3. Pull-Through Device:
 - a. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.
 - b. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

- E. Deflection measuring Device:
 - 1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.
 - 2. Obtain approval of deflection measuring device prior to use.
- F. Deflection Measuring Device Procedure:
 - 1. Measure deflections through each run of installed pipe.
 - 2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.
 - 3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.
- G. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.5 CLEANING

- A. Thoroughly clean storm drain lines, manholes, catch basins, field inlets, culverts, and similar structures, of dirt, debris, and obstructions of any kind.

3.6 VIDEO INSPECTION

- A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the storm drainage line shall be televised with a color closed-circuit television with tilt-head camera recorded in DVD format. The original DVD and log sheets shall be provided to the District.
 - 1. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:
 - a. Low spot (1 inch or greater - mainlines only).
 - b. Joint separations (3/4 inch or greater opening between pipe sections).
 - c. Cocked joints present in straight runs or on the wrong side of pipe curves.
 - d. Chips in pipe ends.
 - e. Cracked or damaged pipe.
 - f. Dropped joints.
 - g. Infiltration.
 - h. Debris or other foreign objects.
 - i. Other obvious deficiencies.
 - j. Irregular condition without logical explanation.

END OF SECTION

SECTION 33 4300

BIO TREATMENT SOIL MIX

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Scarification of Subgrade
 - 2. Installation of import bioswale soil.

1.2 RELATED WORK

- A. Section 31 0000, Earthwork
- B. Section 32 9300, Planting
- C. Section 32 7010, Site Concrete

1.3 REFERENCES

- A. As specified below under 1.05 Submittal Requirements.
- B. Seal of Testing Assurance (STA)

1.4 QUALITY ASSURANCE

- A. Provide written laboratory tests on any required import topsoil, prepared by a reputable firm experienced in the field of soils and plant nutrition.
- B. The laboratories must be STA Certified.
- C. All tests will be paid for by the Owner, but the cost of re-testing of topsoil required because of rejected topsoil submittals will be deducted from the amount due the Contractor under this Section.
- D. Soils for biotreatment or bioretention areas shall meet two objectives:
 - 1. Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
 - 2. Have sufficient moisture retention to support healthy vegetation

1.5 SUBMITTALS

- A. Source of supply of proposed import bioswale soil.
- B. Submittal Requirements - The applicant shall submit to the Architect for approval:
 - 1. A minimum one-gallon size sample of mixed bio treatment soil mix.
 - 2. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
 - 3. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils or Caltrans Test Method (CTM) C202.

4. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 1.04.
 5. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
 6. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
 7. A description of the equipment and methods used to mix the sand and compost to produce Bio Treatment Soil Mix.
 8. Provide the name of the testing laboratory(s) and the following information:
 9. Contact person(s)
 10. Address(s)
 11. Phone contact(s)
 12. E-mail address(s)
 13. Qualifications of laboratory(s), and personnel including date of current certification by USCC, ASTM, Caltrans or approved equal
- C. Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site. Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

1.6 PROJECT CONDITIONS

- A. Do not do subgrade preparation, or topsoil installation until construction work is completed in the area to be planted and the subgrade for topsoil is approved by the Architect.
- B. Protect utilities, paving, and other structures from damage caused by topsoil operations.
- C. Do not purchase or deliver any required import topsoil to the site without the written approval or the proposed topsoil by the Architect.

PART 2 - PRODUCTS

2.1 IMPORT BIOSWALE SOIL

- A. Furnish and install sufficient topsoil to complete the work as indicated on the Drawings and herein specified.
- B. Bioretention soils shall meet the following criteria.
 1. General Requirements – Bioretention soil shall:
 2. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
 3. Support vigorous plant growth.
 4. Consist of the following mixture of fine sand and compost, measured on a volume basis:60%-70%Sand 30%-40% Compost
 5. Sand for Bioretention Soil
 6. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve shall be non-plastic.
 7. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16, 38, #4, and 3/8-inch sieves (ASTM D 422, CTM 202 or as approved by Municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
3/8 inch	100	100

- | | | |
|------------------|----|-----|
| No. 4 | 90 | 100 |
| No. 8 | 70 | 100 |
| No. 16 | 40 | 95 |
| No.30 | 15 | 70 |
| No. 40 or No. 50 | 5 | 55 |
| No. 100 | 0 | 15 |
| No. 200 | 0 | 5 |
8. Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.
 9. Composted Material Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).
 10. Compost Quality Analysis by Laboratory – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council’s Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Examination of Composting and Compost (TMECC). The lab report shall verify:
 11. Organic Matter Content: 35% - 75% by dry wt.
 12. Carbon and Nitrogen Ratio: C:N < 25:1 and C:N > 15:1
 13. Maturity/Stability: any one of the following is required to indicate stability:
 - a. Oxygen Test < 1.3 O₂ /unit TS /hr
 - b. Specific oxy. Test < 1.5)2 /unit BVS /hr
 - c. Respiration test < 8 mg CO₂ /g OM/day
 - d. Dewar test < 20 Temp./ rise (°C) e.
 - e. Solvita® > 5 Index value
 - f. Toxicity: any one of the following measures is sufficient to indicate non-toxicity.
 - g. NH₄- : NO₃-N < 3
 - h. Ammonium < 500 ppm, dry basis
 - i. Seed Germination > 80% of control
 - j. Plant Trials > 5 Index value
 - k. Solvita® > 5 Index value
 - l. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - m. Total Nitrogen content 0.9% or above preferred.
 - n. Boron: Total shall be < 80 ppm.
 - o. Salinity: Must be reported; < 6.0 mmhos/cm
 - p. pH shall be between 6.2 – 8.2. May vary with plant species.
 14. Compost Quality Analysis by Compost Supplier: Before delivery of the compost to the soil supplier the Compost Supplier shall verify the following:
 - a. Feedstock materials shall be specified and include one or more of the following: landscaping/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
 - b. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell or containing recognizable grass or leaves, or is hot (120 deg) upon delivery or rewetting is not acceptable.
 - c. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.
 15. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, ¼ inch, ½ inch, and 1-inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
1 inch	99	100
½ inch	90	100
¼ inch	40	90
No. 200	1	10

16. Bulk density shall be between 500 and 1100 dry lbs/cubic yard.
17. Moisture content shall be between 30% - 55% of dry solids.
18. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1% by weight or volume.
19. Select Pathogens – Salmonella < 3 MPN/4grams of TS, or Coliform Bacteria < 10000 MPN/gram.
20. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.
21. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

C. Verification of alternative bioretention soil mixes

1. Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: “Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation.”
2. The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:
3. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.
4. Submittals – The applicant must submit to the municipality for approval:
 - a. A minimum one-gallon sample of mixed bioretention soil.
 - b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
 - c. Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).
 - d. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, “Loss-On-Ignition Organic Matter Method”.
 - e. Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
 - f. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
 - g. The name of the testing laboratory(s) and the following information:
 - 1) Contact person(s)
 - 2) Address(s)
 - 3) Phone contact(s)
 - 4) E-mail address(s)

- 5) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal
- h. Bioretention Soil
- i. Bioretention Soil Texture. Bioretention Soils shall be analyzed by an accredited lab using #200, and ½” inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	Max
½ inch	97	100
No. 200	2	5

- j. Bioretention Soil Permeability testing. Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:
 - 1) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
 - 2) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the substrate in which the work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities and immediately inform the Architect of any discrepancy between the Drawings and/or specifications and the actual conditions. No work shall be done in any area where there is such a discrepancy until review for same has been given by the Architect.
- B. Coordination: Coordinate work with other trades to insure proper sequencing fitting of construction.

3.3 SUBGRADE PREPARATION

- A. Grades:
 - 1. Subgrades have been established under work of another Section to within 1 inch, plus or minus, of required grades. Subgrades are 6-inches below finished grades, plus or minus 1-inch, allowing for 6-inches of topsoil and soil amendments.
 - 2. Verify that subgrades are within 1” plus or minus, of required subgrades.
 - 3. Notify the Architect prior to commencing soil preparation work if existing grades are not satisfactory, or assume responsibility for conditions as they exist.
- B. Weed and Debris Removal: All ground areas to receive topsoil shall be cleaned of all weeds and debris prior to any subgrade preparation or topsoiling. Weeds and debris shall be disposed of off the site.

- C. Do not perform any subgrade preparation work in areas where soil is contaminated with cement, plaster, paint, or other construction debris. Bring such areas to the attention of the Architect and do not proceed until the contaminated soil is removed and replaced.
- D. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied, if necessary, to bring soil to optimum moisture content for tilling and planting.
- E. Soil Loosening: Soil subgrade in all areas to receive topsoil shall be ripped or cultivated to the depths specified below. Water shall be added, and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement, concrete, and rocks over 2 inches in diameter shall be removed from the site.
 - 1. All areas to be topsoiled: 10 inches deep.

3.4 INSTALLATION OF BIOSWALE SOIL

- A. Do not install bioswale soil until preparation of subgrade has been approved by the Architect.
- B. Moisture Content: Do not work topsoil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form, nor when clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- C. Remove noxious weeds, rocks over 2 inches in diameter, and debris from topsoil, and dispose of off the site.
- D. Thickness of bioswale soil shall conform to those indicated on the site grading plans and specified herein.
- E. Place topsoil and bring to a smooth even grade. Soil shall be thoroughly water settled and high and low areas regraded until the grade of all planting areas conforms to finished grade indicated on the Site Grading Plans to within plus or minus 1".

END OF SECTION

SECTION 33 4727

BIORETENTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Bioretention Soil Mix (BSM)
 - 2. Aggregate Storage
 - 3. Mulch
 - 4. Streambed Gravel / Energy Dissipation Rock
- B. Related Sections:
 - 1. Section 31 2000 – EARTHWORK AND GRADING

1.2 QUALITY ASSURANCE

- A. Comply with the latest editions of the following Standards and Regulations:
 - 1. Caltrans Standard Specifications
 - 2. American Society for Testing and Materials (ASTM), Philadelphia, PA, 1997 or latest edition
 - 3. NDPEs Municipal Regional Permit: Attachment L
 - 4. Alameda County Clean Water Program C.3 Stormwater Technical Guidance document.

1.3 DEFINITIONS

- A. Bioretention Soil Mix (BSM): A soil mix that has been specially blended and tested for use in bioretention facilities with the intent to meet the following objectives:
 - 1. Be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and
 - 2. Have sufficient moisture retention to support healthy vegetation.
 - 3. Consist of the following mixture of fine sand and compost, measured on a volume basis:
 - 60%-70% Sand
 - 30%-40% Compost

1.4 SUBMITTALS

- A. Pre-Installation Submittals: The Contractor shall submit to the Architect for approval:
 - 1. Bioretention Soil Submittals:
 - a. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this specification.
 - b. Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.
 - c. Grain size analysis results of the fine sand component performed in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils or Caltrans Test Method (CTM) C202.
 - d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in PART 4 of this specification section .
 - e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

- f. Grain size analysis results of compost component performed in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils.
 - g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
 - h. Provide the name of the testing laboratory(s) and the following information:
 - 1) Contact person(s)
 - 2) Address(s)
 - 3) Phone contact(s)
 - 4) E-mail address(s)
 - 5) Qualifications of laboratory(s), and personnel including date of current certification by USCC STA, ASTM, Caltrans, or approved equivalent.
2. Other Submittals
- a. Cut sheets of any media or soil admixes to enhance moisture retention properties, if used.
 - b. Testing agency qualifications as specified in Section 1.06.B.
 - c. Streambed gravel / energy dissipation rock sieve analysis.

1.5 QUALITY CONTROL AND QUALITY ASSURANCE

- A. General: Test and inspect bioretention materials and operations as work progresses as described in this section. Failure to detect defective work or materials at any time will not prevent rejection if a defect is discovered after installation, nor shall it constitute final acceptance.
- B. Testing Agency Qualification:
1. General: Agencies that perform testing on bioretention materials, including permeability testing, shall be accredited by STA, ASTM, AASHTO, or other designated recognized standards organization. All certifications shall be current. Testing agency shall be capable of performing all tests to the designated and recognized standards specified and shall provide test results with an accompanying Manufacturer's Certificate of Compliance. Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site. The following information shall be provided for all testing laboratories used:
 - a. Name of lab(s) and contact person(s)
 - b. Address(es) and phone number(s)
 - c. Email address(es)
 - d. Qualifications of laboratory and personnel including the date of current certification by USCC STA, ASTM, Caltrans, or approved equivalent.
 2. Compost: Laboratory that performs testing shall be independent, enrolled in the US Composting Council's (USCC) Compost Analysis Proficiency (CAP) program, and perform testing in accordance with USCC Test Method for The Examination of Composting and Compost (TMECC). The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741, 631-737-4931, www.compostingcouncil.org.
- C. Responsibilities of Contractor
1. Pre-Placement Conference: A pre-placement conference will take place, including at a minimum the Landscape Architect, the Civil Engineer, the District's Representative, Installer, and general Contractor, to review schedule, products, soil testing, permeability testing, and installation. The Contractor shall notify the Civil Engineer a minimum of 5 working days prior to conference.
 2. Testing: All testing specified herein is the responsibility of the Contractor and shall be conducted by an independent testing agency, retained by the Contractor. The District's Representative reserves the right to conduct additional testing on all materials submitted, delivered, or in-place to ensure compliance with Specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect the BSM and mulch from contamination and all sources of additional moisture at supplier site, during transport, and at the project site, until incorporated into the work.
- B. The Contractor is required to coordinate delivery of BSM and aggregates with bioretention facility construction and soil installation. A written schedule shall be submitted for review as part of the submittal package. BSM should not be stockpiled onsite for any length of time. In no case shall BSM be stockpiled onsite for more than 24 hours without prior written approval by the Civil Engineer. If stockpiling onsite for any length of time, BSM stockpiles shall meet the following requirements:
 - 1. Locate stockpiles away from drainage courses, inlets, sewer cleanout vents, and concentrated stormwater flows
 - 2. Place stockpiles on geotextile fabric
 - 3. Cover stockpiles with plastic or comparable material
 - 4. Contain stockpiles (and prevent contamination from adjacent stockpiles) with temporary perimeter barrier (e.g., sand bags, wattles, silt fence).

PART 2 – PRODUCTS

2.1 BIORETENTION SOIL MIX (BSM):

- A. Sand for Bioretention Soil:
 - 1. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic.
 - 2. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16, #8, #4, and 3/8-inch sieves (ASTM C422, Caltrans CTM 202, or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing by Weight	
	Min	Max
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40 or No. 50	5	55
No. 100	0	15
No. 200	0	5

Note: All sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

- B. Composted Material: Compost shall be well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).
1. Compost Quality Analysis by Laboratory – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Examination of Composting and Compost (TMECC). The lab report shall verify:
 - a. Organic Matter Content: 35% to 75% by dry weight.
 - b. Carbon and Nitrogen Ratio: C:N < 25:1 and C:N > 15:1.
 - c. Maturity/Stability: Any one of the following is required to indicate stability:
 - i. Oxygen Test < 1.3 O₂ /unit TS /hr
 - ii. Specific Oxygen Test < 1.5 O₂ / unit BVS /hr
 - iii. Respiration test < 8 mg CO₂-C /g OM / day (or < 8 C / unit VS / day)
 - iv. Dewar test < 20°C temperature rise (maximum)
 - v. Solvita® > 5 Index value
 - d. Toxicity: Any one of the following measures is sufficient to indicate non-toxicity:
 - i. NH₄⁺: NO₃-N < 3
 - ii. Ammonium < 500 ppm, dry basis
 - iii. Seed Germination > 80% of control
 - iv. Plant Trials > 80% of control
 - v. Solvita® > 5 Index value
 - e. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - i. Total Nitrogen content 0.9% or above.
 - ii. Boron: Total shall be < 80 ppm; soluble shall be <2.5 ppm.
 - f. Salinity: Must be reported; < 6.0 mmhos/cm
 - g. pH shall be between 6.5 and 8. May vary with plant species.
 2. Compost Quality Analysis by Compost Supplier – Before delivery of the compost to the soil supplier the Compost Supplier shall verify the following:
 - a. Feedstock materials shall be specified and include one or more of the following: landscaping/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
 - b. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell or containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable.
 - c. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.
 3. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves (ASTM D422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing by Weight	
	<i>Min</i>	<i>Max</i>
1 inch	99	100
1/2 inch	90	100
1/4 inch ¹	40	99
No. 200	1	10

- ¹ Max percent passing by Weight for the ¼ inch sieve has been increased in response to locally available materials.
4. Bulk density shall be between 500 to 1,100 dry lbs/cubic yard.
 5. Moisture content shall be between 30% - 55% of dry solids.
 6. Inerts - compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1% by weight or volume.
 7. Select Pathogens – Salmonella < 3 MPN/4 grams of TS, or Coliform Bacteria < 10,000 MPN/gram.
 8. Trace Contaminants Metals (lead, mercury, etc.): Product must meet US EPA, 40 CFR 503 regulations.
 9. Compost Testing – The compost supplier shall test all compost products within 120 calendar days prior to application. Samples shall be taken using the STA sample collection protocol. The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741, phone: 631-737-4931, www.compostingcouncil.org. The sample shall be sent to an independent STA Program-approved lab.

2.2 VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

- A. Alternative soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility and provide sufficient retention of moisture and nutrients to support healthy vegetation.
1. General Requirements: Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall support vigorous plant growth.
 - a. Pre-installation Submittals: The applicant shall submit the soil mixture for approval.
 - i. A minimum one-gallon size sample of mixed bioretention soil.
 - ii. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this specification.
 - iii. Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 2.02.1.b(ii)(2) below.
 - iv. Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.
 - v. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
 - vi. Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils.
 - vii. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
 - viii. Provide the name of the testing laboratory(s) and the following information:
 - 1) Contact person(s)
 - 2) Address(s)
 - 3) Phone contact(s)
 - 4) E-mail address(s)
 - 5) Qualifications of laboratory(s), and personnel including date of current certification by USCC STA, ASTM, Caltrans, or approved equivalent.
- B. Bioretention Soil Mix (BSM)
 1. Bioretention Soil Texture: Bioretention soil mix shall be analyzed by an accredited lab using #200, and ½ inch sieves (ASTM D422 or as approved by the local municipality), and meet the following gradation:

Sieve Size	Percent Passing (by Weight)	
	Min	Max
1/2 inch	97	100
No. 200	2	5

ii. Bioretention Soil Permeability testing: Bioretention soil mix shall be analyzed by an accredited geotechnical laboratory for the following tests:

- 1) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
- 2) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

2.3 AGGREGATE STORAGE

- A. Aggregate Storage shall be Class 2 permeable material per Caltrans Standard Specification Section 68-2.02F(3) and shall consist of hard, durable, and clean, sand, gravel, or mechanically crushed stone, substantially free from adherent coatings. Materials shall be washed thoroughly to remove fines, organic matter, extraneous debris, or objectionable materials. On-site recycled materials are not permitted.
- B. Aggregate Storage shall meet the following specifications for grading and quality:
 1. Aggregate gradation testing in accordance with ASTM C136 at least once per 500 cubic yards.

Sieve ¹	Percent Passing by Weight
	Caltrans Class 2 Permeable Aggregate ³
1 inch	100
3/4 inch	90 to 100
1/2 inch	–
3/8 inch	40 to 100
No. 4	25 to 40
No. 8	18 to 33
No. 16	–
No. 30	5 to 15
No. 50	0 to 7
No. 200 ²	0 to 3

¹ Sieve provided in nominal size square openings or United States Standard Sieve Series sizes.

- 2. ² Gradation modified from ASTM for portion passing the No. 200 sieve.
- 3. ³ Per Caltrans Standard Specification Section 68-2.02F(3). Crushed Particles: 90 percent (minimum) fractured faces tested in accordance with California Test 205. Do not use rounded river gravel.
- 4. L.A. Abrasion: 40 percent (maximum) tested in accordance with ASTM C 131.

2.4 MULCH

A. General

- 1. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist and replenishes soil nutrients.
- 2. Mulch must not contain more than 0.1 percent of deleterious materials such as rocks, glass, plastics, metals, clods, weeds, weed seeds, coarse objects, sticks larger than the specified particle size, salts, paint, petroleum products, pesticides or other chemical residues harmful to plant or animal life.
- 3. Mulch shall be tree trimming mulch, or approved equivalent such as arbor mulch.

B. Tree Trimming Mulch

- 1. Tree trimming mulch must be derived from chipped trees and may contain leaves and small twigs. Materials shall conform to Caltrans Standard Specification Section 20-5.04B(5).
- 2. Tree trimming mulch must have a particle size such that a minimum of 95 percent of the material by volume is less than 3 inches and no more than 30 percent by volume is less than 1 inch.

2.5 STREAMBED GRAVEL / ENERGY DISSIPATION ROCK

A. General

- 1. Streambed Cobbles shall be clean, naturally occurring water rounded gravel material.
- 2. Streambed Cobbles shall have a well-graded distribution of cobble sizes and conform to the following gradation:

Streambed Cobbles	
Approximate Size	Percent Passing by Weight
5 inch	100
4 inch	90–100
3 inch	25–40
2 inch	0–10

- a. Approximate size can be determined by taking the average dimension of the three axes of the rock, Length, Width, and Thickness, by use of the following calculation: $(\text{Length} + \text{Width} + \text{Thickness})/3 = \text{Approximate Size}$ Length is the longest axis, width is the second longest axis, and thickness is the shortest axis.
- 3. The grading of the cobbles shall be determined by the Contractor by visual inspection of the load before it is dumped into place, or, if so ordered by the Civil Engineer, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load.
- 4. Cobbles must be washed before placement.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prevent runoff from adjacent pervious and impervious surfaces from entering the bioretention facility (e.g., sand bag roof drains, flow diversion) until authorization is given by the Civil Engineer.
- B. Exclude equipment from bioretention facilities. No equipment shall operate within the facility once bioretention facility construction has begun, including during and after excavation, backfilling, mulching, or planting.
- C. Prevent foreign materials and substances, such as silt laden run-off, construction debris, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid from entering or being stored in the facility at any point during construction.
- D. The District's Representative may, at any time, conduct additional testing on all materials submitted, delivered, or in-place, to ensure compliance with the Specifications. Testing may include permeability testing per ASTM D2434 (Modified), density testing per ASTM D6938, etc., if the Engineer/Landscape Architect suspects the facility does not conform to these specifications (e.g., as evidenced by lower than anticipated infiltration capacity).
- E. Contractor to provide Civil Engineer written records documenting dates; company name of participants; descriptions; locations; and results of tests and/or measurements undertaken as described in PART 3 of this specification. Contractor to provide written records to Civil Engineer no more than 2 work days after completion of test and/or measurement (e.g. "01 January 2018, Cherry Tree Landscapes, soil density measured, FTP 01, 81 percent compaction").

3.2 GRADING

- A. The Contractor shall not start bioretention facility grading until all areas draining to the facility are stabilized and authorization has been given by the Civil Engineer.
- B. Construct bioretention facility subgrade to +/- $\frac{3}{4}$ inch of the grades and slopes specified on the construction documents.
- C. Excavation within 6 inches of final native soil grade shall not be permitted if facility soils have standing water, or have been subjected to more than $\frac{1}{2}$ inch of precipitation within the previous 48 hours.

3.3 SUBGRADE PREPARATION AND PROTECTION

- A. Protect the bioretention excavation from over compaction and/or contamination.
 - 1. Areas which have been over compacted by equipment or vehicle traffic or by other means and which need to be ripped, over excavated receive additional scarification, or other restorative means shall be done at the Contractor's expense and at the direction of the Civil Engineer.
 - 2. Excavated areas contaminated by sediment-laden runoff prior to placement of BSM or aggregate storage material shall be remediated at the Contractor's expense by removing the contaminated soil (top 3 inches minimum) and replacing with a suitable material, as determined by the Civil Engineer.
- B. Remove all trash, debris, construction waste, cement dust and/or slurry, or any other materials that may impede infiltration into prepare subgrade.

- C. The subgrade shall be inspected and accepted by the Civil Engineer prior to placement of any materials or final subgrade scarification.
- D. Scarify the surface of the subgrade to a minimum depth of 3 inches immediately prior to placement of BSM or aggregate storage material. Acceptable methods of scarification include use of excavator bucket teeth or a rototiller to loosen the surface of the subgrade.
- E. Place aggregate storage material where shown on drawings with conveyor belt or with an excavator or loader from a height no higher than 6 feet unless otherwise approved by the Engineer. Do not dump material directly from truck into the cell.
- F. Aggregate storage areas contaminated by sediment-laden runoff prior to placement of BSM shall be remediated at the Contractor's expense by removing the contaminated aggregate storage material (top 3 inches minimum or as directed by the Civil Engineer and replacing with clean aggregate storage material per Section 2.03, to the lines and grades on the contract documents.
- G. Aggregate storage material shall be inspected and accepted for placement and finish grade by the Engineer prior to the installation of BSM. Any material that does not conform to this specification shall be removed and replaced with acceptable material or remediated to the satisfaction of the Civil Engineer, at the Contractors' expense.

3.4 BIORETENTION SOIL MIX (BSM) PLACEMENT

- A. The Contractor shall not place BSM until the [District's/Owner's Representative] has reviewed and confirmed the following:
 - 1. BSM delivery ticket(s): Delivery tickets shall show that the full delivered amount of BSM matches the product type, volume and manufacturer named in the submittals. Each delivered batch of BSM shall be accompanied by a certification letter from the supplier verifying that the material meets specifications and is supplied from the approved BSM stockpile.
 - 2. Visual match with submitted samples: Delivered product will be compared to the submitted 1-gallon sample, to verify that it matches the submitted sample. The Civil Engineer may inspect any loads of BSM on delivery and stop placement if the soil does not appear to match the submittals; and require sampling and testing of the delivered soil to determine if the soil meets the requirements of Section 2.01 of this specification before authorizing soil placement.
 - 3. Inspection of the aggregate storage layer, underdrain, cleanout, and overflow structure installation by the Civil Engineer or third-party peer reviewer, to confirm it is built per plan.
- B. BSM placement, grading and consolidation shall not occur when the BSM is excessively wet, or has been subjected to more than 1/2 inch of precipitation within 48 hours prior to placement. Excessively wet is defined as being at or above 22 percent soil moisture by a General Tools & Instruments DSMM500 Precision Digital Soil Moisture Meter with Probe (or equivalent). A minimum of three readings with the soil moisture probe will be used to determine the average percent soil moisture reading per each truck load. There should be no visible free water in the material.
- C. The Contractor shall place BSM loosely with a conveyor belt or other means from a height no higher than 6 feet, unless otherwise approved by the Civil Engineer. Soil shall be placed in accordance with these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown in the Drawings or as established by the Civil Engineer.
- D. Excessively dry BSM may be lightly and uniformly moistened, as necessary, to facilitate placement and workability.

- E. Compact BSM using non-mechanical compaction methods (e.g., boot packing, hand tamping, or water consolidation) to 83 percent (+/- 2 percent) of the maximum dry density per modified Proctor test (ASTM D1557), or as directed by the Geotechnical Engineer. Determination of in-place density shall be made using a nuclear gauge per ASTM D6938. Moisture content determination shall be conducted on a soil sample taken at the location of the nuclear gage reading per ASTM D2216.
- F. Grade BSM to a smooth, uniform surface plane with loose, uniformly fine texture. Rake, remove ridges, and fill depressions to meet finish grades.
- G. Final soil depth shall be measured and verified only after the soil has been compacted. If after consolidation, the soil is not within +/- 3/4 inch of the grades and slopes specified on the Plans, add material to bring it up to final grade and rake.
- H. The BSM shall be inspected and accepted for placement and finish grade by the Civil Engineer prior to the installation of planting and mulch. Any BSM that does not conform to this Specification shall be remediated to the satisfaction of the Civil Engineer, or removed and replaced with acceptable BSM, at the Contractor's expense.

3.5 PLANTING AND MULCHING

- A. Bioretention facilities shall be planted and mulched as shown on the contract documents.
- B. Bioretention facilities shall not be planted or mulched when soils are excessively wet as defined in Section 3.04 of this specification.
- C. Bioretention facility areas contaminated by sediment laden runoff prior to planting or placement of mulch shall be remediated at the Contractor's expense by removing the contaminated BSM (top 3 inches minimum) and replacing with BSM per Section 2.01 of this specification, to the lines and grades on the contract documents.
- D. All mulch shall be inspected and accepted by the Landscape Architect to ensure appropriate depth and material prior to facility commissioning (e.g., unblocking of inlets).

3.6 FLOOD TESTING

- A. Inlets shall be constructed per the contract documents and free from all obstructions prior to commencing flow testing.
- B. Testing shall be conducted at the conclusion of the 90-day plant grow-in period. Protection and flow diversion measures shall be removed in their entirety prior to commencing flow testing.
- C. Underdrains shall be plugged at the outlet structure to minimize water consumption during testing.
- D. Prior to testing, broom sweep gutter and other impervious surfaces within the test area to remove sediments and other objectionable materials.
- E. The Civil Engineer shall be present during the demonstration. The Contractor shall notify the Civil Engineer a minimum of 5 working days prior to testing.
- F. The Contractor shall water test each facility to demonstrate that all inlet curb openings are capturing and diverting all water in the gutter to the facility, outlet structures are engaging at the elevation specified, and the designed ponding depth is achieved. Testing shall include application of water from a hydrant or water truck, at a minimum rate of 10 gallons per minute, into the gutter a minimum of 15 feet upstream of the inlet curb opening being tested.

Each inlet shall be tested individually. If erosion occurs during testing, restore soils, plants, and other affected materials.

- G. Landscape Architect and/or Civil Engineer will identify deficiencies and required corrections, including but not limited to relocating misplaced plants, adjusting streambed gravel, adjusting mulch, adjusting inlets, splash aprons, and forebays, removing and replacing inlets, and removing debris.
- H. Once adjustments are made, the Contractor shall re-test to confirm all test water flows into the facility from the roof drains and correct any remaining deficiencies identified by Civil Engineer.
- I. Inlets, outlets, and other bioretention facility appurtenances shall not be accepted until testing and any required correction and retesting is complete and accepted by the Civil Engineer.

END OF SECTION

APPENDICES

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS, 2019 CBC

Application Number: 01-119056

School Name: Las Positas College

School District: Chabot-Las Positas
Community College District

DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

2019 CBC

IMPORTANT: This form is only a summary list of structural tests and some of the special inspections required for the project. Generally, the structural tests and special inspections noted on this form are those that will be performed by the Geotechnical Engineer of Record, Laboratory of Record, or Special Inspector. The actual complete test and inspection program must be performed as detailed on the DSA approved documents. The appendix at the bottom of this form identifies work NOT subject to DSA requirements for special inspection or structural testing. The project inspector is responsible for providing inspection of all facets of construction, including but not limited to, special inspections not listed on this form such as structural wood framing, high-load wood diaphragms, cold-formed steel framing, anchorage of non-structural components, etc., per Title 24, Part 2, Chapter 17A (2019 CBC).

KEY TO COLUMNS

1. TYPE	2. PERFORMED BY
<p>Continuous – Indicates that a continuous special inspection is required</p> <p>Periodic – Indicates that a periodic special inspection is required</p> <p>Test – Indicates that a test is required</p>	<p>GE – Indicates that the special inspection shall be performed by a registered geotechnical engineer or his or her authorized representative.</p> <p>LOR – Indicates that the test or special inspection shall be performed by a testing laboratory accepted in the DSA Laboratory Evaluation and Acceptance (LEA) Program. See CAC Section 4-335.</p> <p>PI – Indicates that the special inspection may be performed by a project inspector when specifically approved by DSA.</p> <p>SI – Indicates that the special inspection shall be performed by an appropriately qualified/approved special inspector.</p>

****NOTE:** Undefined section and table references found in this document are from the CBC, or California Building Code.

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SOILS), 2019 CBC

Application Number: 01-119056

School Name: Las Positas College

School District: Chabot-Las Positas

Community College District

DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

Geotechnical Reports: Project has a geotechnical report, or CDs indicate soils special inspection is required by GE

1. GENERAL:		Table 1705A.6		
Test or Special Inspection	Type	Performed By	Code References and Notes	
<input checked="" type="checkbox"/> <p>a. Verify that:</p> <ul style="list-style-type: none"> • Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations. • Foundation excavations are extended to proper depth and have reached proper material. • Materials below footings are adequate to achieve the design bearing capacity. 	Periodic	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)	

2. SOIL COMPACTION AND FILL:		Table 1705A.6		
Test or Special Inspection	Type	Performed By	Code References and Notes	
<input checked="" type="checkbox"/> <p>a. Perform classification and testing of fill materials.</p>	Test	LOR*	* Under the supervision of the geotechnical engineer.	
<input checked="" type="checkbox"/> <p>b. Verify use of proper materials, densities and inspect lift thicknesses, placement and compaction during placement of fill.</p>	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (Refer to specific items identified in the Appendix for exemptions where soils SI and testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil SI and test reporting requirements for the exempt items.)	
<input checked="" type="checkbox"/> <p>c. Compaction testing.</p>	Test	LOR*	* Under the supervision of the geotechnical engineer. (Refer to specific items identified in the Appendix for exemptions where soils testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil test reporting requirements for the exempt items.)	

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SOILS), 2019 CBC

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3. DRIVEN DEEP FOUNDATIONS (PILES):		Table 1705A.7		
Test or Special Inspection		Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Verify pile materials, sizes and lengths comply with the requirements.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	b. Determine capacities of test piles and conduct additional load tests as required.	Test	LOR*	* Under the supervision of the geotechnical engineer.
<input type="checkbox"/>	c. Inspect driving operations and maintain complete and accurate records for each pile.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	d. Verify locations of piles and their plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and record any pile damage.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	e. Steel piles.	Provide tests and inspections per STEEL section below.		
<input type="checkbox"/>	f. Concrete piles and concrete filled piles.	Provide tests and inspections per CONCRETE section below.		
<input type="checkbox"/>	g. For specialty piles, perform additional inspections as determined by the registered design professional in responsible charge.	*	*	* As defined on drawings or specifications.

4. CAST-IN-PLACE DEEP FOUNDATIONS (PIERS):		Table 1705A.8		
Test or Special Inspection		Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect drilling operations and maintain complete and accurate records for each pier.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	b. Verify pier locations, diameters, plumbness, bell diameters (if applicable), lengths and embedment into	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SOILS), 2019 CBC

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School Name: Las Positas College

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DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

	bedrock (if applicable); record concrete or grout volumes.			
<input checked="" type="checkbox"/>	c. Confirm adequate end strata bearing capacity.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	d. Concrete piers.	Provide tests and inspections per CONCRETE section below.		

5. RETAINING WALLS:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Placement, compaction and inspection of backfill.	Continuous	GE*	1705A.6.1. * By geotechnical engineer or his or her qualified representative. (See Section 2 above).
<input type="checkbox"/>	b. Placement of soil reinforcement and/or drainage devices.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	c. Segmental retaining walls; inspect placement of units, dowels, connectors, etc.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. See DSA IR 16-3.
<input type="checkbox"/>	d. Concrete retaining walls.	Provide tests and inspections per CONCRETE section below.		
<input type="checkbox"/>	e. Masonry retaining walls.	Provide tests and inspections per MASONRY section below.		

6. OTHER SOILS:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Soil Improvements	Test	GE*	Submit a comprehensive report documenting final soil improvements constructed, construction observation and the results of the confirmation testing and analysis to CGS for final

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SOILS), 2019 CBC

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Increment Number:

Date Submitted: 7/7/2020

				acceptance. * By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	b. Inspection of Soil Improvements	Continuous	GE*	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>				

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Concrete), 2019 CBC

Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

Application Number: 01-119056

School Name: Las Positas College

School District: Chabot-Las Positas
Community College District

DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

7. CAST-IN-PLACE CONCRETE				
Material Verification and Testing:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify use of required design mix.	Periodic	SI	Table 1705A.3 Item 5, 1910A.1.
<input checked="" type="checkbox"/>	b. Identify, sample, and test reinforcing steel.	Test	LOR	1910A.2; ACI 318-14 Section 26.6.1.2; DSA IR 17-10. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	c. During concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	Test	LOR	Table 1705A.3 Item 6; ACI 318-14 Sections 26.5 & 26.12.
<input checked="" type="checkbox"/>	d. Test concrete (f_c).	Test	LOR	1905A.1.15; ACI 318-14 Section 26.12.
Inspection:				
<input checked="" type="checkbox"/>	e. Batch plant inspection:	See Notes	SI	Default of 'Continuous' per 1705A.3.3. If approved by DSA, batch plant inspection may be reduced to 'Periodic' subject to requirements in Section 1705A.3.3.1, or eliminated per 1705A.3.3.2. (See Appendix for exemptions.)
<input type="checkbox"/>	f. Welding of reinforcing steel.	Provide special inspection per STEEL, Category 19.1(d) & (e) and/or 19.2(g) & (h) below.		

8. PRESTRESSED / POST-TENSIONED CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Sample and test prestressing tendons and anchorages.	Test	LOR	1705A.3.4, 1910A.3
<input type="checkbox"/>	b. Inspect placement of prestressing tendons.	Periodic	SI	1705A.3.4, Table 1705A.3 Items 1 & 9.

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Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

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<input type="checkbox"/>	c. Verify in-situ concrete strength prior to stressing of post-tensioning tendons.	Periodic	SI	Table 1705A.3 Item 11. Special inspector to verify specified concrete strength test prior to stressing.
<input type="checkbox"/>	d. Inspect application of post-tensioning or prestressing forces and grouting of bonded prestressing tendons.	Continuous	SI	1705A.3.4, Table 1705A.3 Item 9; ACI 318-14 Section 26.13

9. PRECAST CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Inspect fabrication of precast concrete members.	Continuous	SI	ACI 318-14 Section 26.13.
<input type="checkbox"/>	b. Inspect erection of precast concrete members.	Periodic	SI*	Table 1705A.3 Item 10. * May be performed by PI when specifically approved by DSA.

10. SHOTCRETE (in addition to Cast-in-Place Concrete tests and inspections):

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Inspect shotcrete placement for proper application techniques.	Continuous	SI	1705A.19, Table 1705A.3 Item 7, 1908A.6, 1908A.7, 1908A.8, 1908A.9, 1908A.11, 1908A.12. See ACI 506.2-13 Section 3.4, ACI 506R-16.
<input type="checkbox"/>	b. Sample and test shotcrete (f'_c).	Test	LOR	1908A.5, 1908A.10.

11. POST-INSTALLED ANCHORS:

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect installation of post-installed anchors	See Notes	SI*	1617A.1.19, Table 1705A.3 Item 4a (Continuous) & 4b (Periodic), 1705A.3.8 (See Appendix for exemptions). ACI 318-14

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Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

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				Sections 17.8 & 26.13. * May be performed by the project inspector when specifically approved by DSA.
<input checked="" type="checkbox"/>	b. Test post-installed anchors.	Test	LOR	1910A.5. (See Appendix for exemptions.)

12. OTHER CONCRETE:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>				

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1705A.4; TMS 602-16, Tables 3 and 4.**

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13. STRUCTURAL MASONRY: 2000 psi				
Material Verification and Testing: (See Appendix for exemptions.)				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Mill certificate indicates compliance with requirements for reinforcement, anchors, ties, fasteners and metal accessories. See item 7b for identification, sampling and testing of reinforcing steel.	Periodic	SI*	2103A.4; TMS 602-16 Articles 1.5B.2 & 2.4. *To be performed by qualified LOR representative. Applicable testing by LOR. See DSA IR 17-10 for unidentified reinforcing steel.
<input checked="" type="checkbox"/>	b. Producer's certificate of compliance for masonry units, mortar and grout materials.	Test	LOR	1705A.4, 2103A.2.1, 2103A.3, 2103A.5; TMS 602-16 Articles 2.1, 2.2, 2.6A and 2.6B, and Table 6 footnote 3.
<input checked="" type="checkbox"/>	c. Test masonry (f'_m).	Test	LOR	1705A.4. For Unit Strength: 2105A.3 (2114.6.1*); TMS 602-16 Articles 1.4B.2, 1.5B.1 & 1.5B.2. For Prism (required when $f'_m > 2000$ psi): 2105A.2; TMS 602-16 Articles 1.4B.3, 1.4B.4, 1.5B.1 & 1.5B.2.
<input checked="" type="checkbox"/>	d. Verify proportions of site-prepared, premixed or preblended mortar and grout.	Periodic	SI	TMS 602-16 Table 3 Item 5, Table 4 Item 1a & 2d.
<input checked="" type="checkbox"/>	e. Test core-drilled samples.	Test	LOR	2105A.4. (See Appendix for exemptions.)
Inspection: (See Appendix for exemptions.)				
<input checked="" type="checkbox"/>	f. Inspect preparation of prisms.	Continuous	SI	TMS 602-16 Articles 1.4.B.3 & 1.4.B.4 & Table 4 Item 4.
<input checked="" type="checkbox"/>	g. Verify size, location and condition of all dowels, construction supporting masonry, etc.	Periodic	SI	

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<input checked="" type="checkbox"/>	h. Verify size, grade and type of reinforcement and anchor bolts.	Periodic	SI	TMS 602-16 Table 4 Item 1c.
<input type="checkbox"/>	i. Welding of reinforcing steel.	TMS 602-16 Table 4 Item 3e. Provide special inspection per STEEL, Category 19.1(d) & (e) and/or 19.2(g) & (h) below.		
<input checked="" type="checkbox"/>	j. Inspect placement of reinforcement and connectors.	Continuous	SI	TMS 602-16 Table 4 Item 2c.
<input checked="" type="checkbox"/>	k. Inspect placement of masonry units and construction of mortar joints.	Periodic	SI	TMS 602-16 Table 4 Item 3b.
<input checked="" type="checkbox"/>	l. Verify preparation, construction and protection of masonry during cold weather (temperature below 40° F) or hot weather (temperature above 90° F).	Periodic	SI*	TMS 602-16 Table 4 Item 3f. * May be performed by the project inspector when specifically approved by DSA.
<input checked="" type="checkbox"/>	m. Inspect type, size and location of anchors and all other items to embedded in masonry including other details of anchorage of masonry to structural members, frames and other construction.	Continuous	SI	TMS 602-16 Table 4 Item 3d.
<input checked="" type="checkbox"/>	n. Inspect grout space prior to placement of grout.	Continuous	SI	TMS 602-16 Table 4 Item 2a.

14. VENEER OR GLASS BLOCK PARTITIONS: 1705A.4.1; TMS 602-16 Tables 3 and 4.

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Verify proportions of site-prepared mortar and grout and/or verify certification of premixed mortar.	Periodic	SI	TMS 602-16 Table 3 Item 5 and Table 4 Items 1a & 2d.
<input type="checkbox"/>	b. Inspect placement of units and construction of mortar joints.	Periodic	SI	TMS 602-16 Table 4 Item 3b.

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1705A.4; TMS 602-16, Tables 3 and 4.**

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<input type="checkbox"/>	c. Inspect placement of reinforcement, connectors and anchors.	Periodic	SI	TMS 602-16 Table 4 Item 2c.
<input type="checkbox"/>	d. Inspect type, size and location of anchors and all other items to be embedded in masonry including details of anchorage of masonry to structural members, frames and other construction.	Periodic	SI	TMS 602-16 Table 4 Item 3d.
<input type="checkbox"/>	e. Verify preparation, construction and protection of masonry during cold weather (temperature below 40° F) or hot weather (above 90° F).	Periodic	SI*	TMS 602-16 Table 4 Item 3f. * May be performed by the project inspector when specifically approved by DSA.
<input type="checkbox"/>	f. Test veneer bond strength.	Test	LOR	1410.2.1; TMS 402 Article 12.3.2.4. (Field constructed mock-up laboratory tested in accordance with ASTM C482).
15. POST-INSTALLED ANCHORS IN MASONRY:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Inspect installation of post-installed anchors	See Notes	SI*	1617A.1.19, 1705A.4, Table 1705A.3 Item 4a (Continuous) & 4b (Periodic); ACI 318-14 Sections 17.8 & 26.13. * May be performed by the project inspector when specifically approved by DSA. (See Appendix for exemptions.)
<input type="checkbox"/>	b. Test post-installed anchors.	Test	LOR	1705A.4, 1910A.5. (See Appendix for exemptions.)
16. OTHER MASONRY:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>				

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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17. STRUCTURAL STEEL, COLD-FORMED STEEL AND ALUMINUM USED FOR STRUCTURAL PURPOSES				
Material Verification and Testing:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify identification of all materials and: <ul style="list-style-type: none"> • Mill certificates indicate material properties that comply with requirements. • Material sizes, types and grades comply with requirements. 	Periodic	*	Table 1705A.2.1 Item 3a–3c. 2202A.1; AISI S100-16 Section A3.1 & A3.2, AISI S240-15 Section A3 & A5, AISI S220-15 Sections A4 & A6. * By special inspector or qualified technician when performed off-site.
<input checked="" type="checkbox"/>	b. Test unidentified materials	Test	LOR	2202A.1.
<input checked="" type="checkbox"/>	c. Examine seam welds of HSS shapes	Periodic	SI	DSA IR 17-3.
Inspection:				
<input checked="" type="checkbox"/>	d. Verify and document steel fabrication per DSA-approved construction documents.	Periodic	SI	Not applicable to cold-formed steel light-frame construction, except for trusses (1705A.2.4).

18. HIGH-STRENGTH BOLTS: RCSC 2014				
Material Verification and Testing of High-Strength Bolts, Nuts and Washers:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the DSA-approved documents.	Periodic	SI	Table 1705A.2.1 Items 1a & 1b, 2202A.1; AISC 360-16 Section A3.3, J3.1, and N3.2; RCSC 2014 Section 1.5 & 2.1; DSA IR 17-8 & DSA IR 17-9.
<input checked="" type="checkbox"/>	b. Test high-strength bolts, nuts and washers.	Test	LOR	Table 1705A.2.1 Item 1c, 2213A.1; RCSC 2014 Section 7.2; DSA IR 17-8.
Inspection of High-Strength Bolt Installation:				

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input checked="" type="checkbox"/>	c. Bearing-type ("snug tight") connections.	Periodic	SI	Table 1705A.2.1 Item 2a, 1705A.2.6, 2204A.2; AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Section 9.1; DSA IR 17-9.
<input checked="" type="checkbox"/>	d. Pretensioned and slip-critical connections.	*	SI	Table 1705A.2.1 Items 2b & 2c, 1705A.2.6, 2204A.2; AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Sections 9.2 & 9.3; DSA IR 17-9. * "Continuous" or "Periodic" depends on the tightening method used.

19. WELDING:	1705A.2.5, Table 1705A.2.1 Items 4 & 5; AWS D1.1 and AWS D1.8 for structural steel; AWS D1.2 for Aluminum; AWS D1.3 for cold-formed steel; AWS D1.4 for reinforcing steel; DSA IR 17-3 (See Appendix for exemptions.)
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Verification of Materials, Equipment, Welders, etc.:

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify weld filler material identification markings per AWS designation listed on the DSA-approved documents and the WPS.	Periodic	SI	DSA IR 17-3.
<input checked="" type="checkbox"/>	b. Verify weld filler material manufacturer's certificate of compliance.	Periodic	SI	DSA IR 17-3.
<input checked="" type="checkbox"/>	c. Verify WPS, welder qualifications and equipment.	Periodic	SI	DSA IR 17-3.

19.1 SHOP WELDING:

	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	Continuous	SI	Table 1705A.2.1 Items 5a.1-4; AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
<input checked="" type="checkbox"/>	b. Inspect single-pass fillet welds ≤ 5/16", floor and roof deck welds.	Periodic	SI	1705A.2.2, Table 1705A.2.1 Items 5a.5 & 5a.6; AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
<input type="checkbox"/>	c. Inspect welding of stairs and railing systems.	Periodic	SI	1705A.2.1; AISC 360-16 (and AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3.

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input type="checkbox"/>	d. Verification of reinforcing steel weldability other than ASTM A706.	Periodic	SI	1705A.3.1; AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
<input type="checkbox"/>	e. Inspect welding of reinforcing steel.	Continuous	SI	Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8; AWS D1.4; DSA IR 17-3.
19.2 FIELD WELDING:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	Continuous	SI	Table 1705A.2.1 Items 5a.1–4; AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.
<input checked="" type="checkbox"/>	b. Inspect single-pass fillet welds ≤ 5/16".	Periodic	SI	Table 1705A.2.1 Item 5a.5; AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.
<input type="checkbox"/>	c. Inspect end-welded studs (ASTM A-108) installation (including bend test).	Periodic	SI	2213A.2; AISC 360-16 (AISC 341-16 as applicable); AWS D1.1; DSA IR 17-3.
<input checked="" type="checkbox"/>	d. Inspect floor and roof deck welds.	Periodic	SI	1705A.2.2, Table 1705A.2.1 Item 5a.6; AISC 360-16 (AISC 341-16 as applicable); AWS D1.3; DSA IR 17-3.
<input checked="" type="checkbox"/>	e. Inspect welding of structural cold-formed steel.	Periodic	SI*	1705A.2.5; AWS D1.3; DSA IR 17-3. The quality control provisions of AISI S240-15 Chapter D shall also apply. * May be performed by the project inspector when specifically approved by DSA.
<input type="checkbox"/>	f. Inspect welding of stairs and railing systems.	Periodic	SI*	1705A.2.1; AISC 360-16 (AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3. * May be performed by the project inspector when specifically approved by DSA.
<input type="checkbox"/>	g. Verification of reinforcing steel weldability.	Periodic	SI	1705A.3.1; AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
<input type="checkbox"/>	h. Inspect welding of reinforcing steel.	Continuous	SI	Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8; AWS D1.4; DSA IR 17-3.

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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20. NONDESTRUCTIVE TESTING: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Ultrasonic	Test	LOR	1705A.2.1, 1705A.2.5; AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.
<input checked="" type="checkbox"/>	b. Magnetic Particle	Test	LOR	1705A.2.1, 1705A.2.5; AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.
<input type="checkbox"/>	c.	Test	LOR	

21. STEEL JOISTS AND TRUSSES: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Verify size, type and grade for all chord and web members as well as connectors and weld filler material; verify joist profile, dimensions and camber (if applicable); verify all weld locations, lengths and profiles; mark or tag each joist.	Continuous	SI	1705A.2.3, Table 1705A.2.3; AWS D1.1; DSA IR 22-3 for steel joists only. 1705A.2.4; AWS D1.3 for cold-formed steel trusses.

22. SPRAY APPLIED FIRE-PROOFING: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16				
	Test or Special Inspection	Type	Performed By	Code References and Notes

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input type="checkbox"/>	a. Examine structural steel surface conditions, inspect application, take samples, measure thickness and verify compliance of all aspects of application with DSA-approved documents.	Periodic	SI	1705A.14.
<input type="checkbox"/>	b. Test bond strength.	Test	LOR	1705A.14.6.
<input type="checkbox"/>	c. Test density.	Test	LOR	1705A.14.5.

23. ANCHOR BOLTS AND ANCHOR RODS:				
<input checked="" type="checkbox"/>	a. Anchor Bolts and Anchor Rods	Test	LOR	Sample and test anchor bolts and anchor rods not readily identifiable per procedures noted in DSA IR 17-11.
<input type="checkbox"/>	b. Threaded rod not used for foundation anchorage.	Test	LOR	Sample and test threaded rods not readily identifiable per procedures noted in DSA IR 17-11.

23.1 OTHER STEEL:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>				

Appendix: Work Exempt from DSA Requirements for Structural Tests / Special Inspections

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Exempt items given in DSA IR A-22 or the 2019 CBC (including DSA amendments) and those items identified below with an "X" by the design professional are NOT subject to DSA requirements for the structural tests / special inspections noted. **Items marked as exempt shall be identified on the approved construction documents.** The project inspector shall verify all construction complies with the approved construction documents.

	SOILS:
<input type="checkbox"/>	1. Deep foundations acting as a cantilever footing designed based on minimum allowable pressures per CBC Table 1806A.2 and having no geotechnical report for the following cases: A) free standing sign or scoreboard, B) cell or antenna towers and poles less than 35'-0" tall (e.g., lighting poles, flag poles, poles supporting open mesh fences, etc.), C) single-story structure with dead load less than 5 psf (e.g., open fabric shade structure), or D) covered walkway structure with an apex height less than 10'-0" above adjacent grade.
<input type="checkbox"/>	2. Shallow foundations, etc. are exempt from special inspections and testing by a Geotechnical Engineer for the following cases: A) buildings without a geotechnical report and meeting the exception Item #1 criteria in CBC Section 1803A.2 supported by native soil (any excavation depth) or fill soil (not exceeding 12" depth per CBC, Section 1804A.6), B) soil scarification/recompaction not exceeding 12" depth, C) native or fill soil supporting exterior non-structural flatwork (e.g., sidewalks, site concrete ramps, site stairs, parking lots, driveways, etc.), D) unpaved landscaping and playground areas, or E) utility trench backfill.

	CONCRETE/MASONRY:
<input type="checkbox"/>	1. Post-installed anchors for the following: A) exempt non-structural components (e.g., mechanical, electrical, plumbing equipment - see Item 7 for "Welding") given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) or B) interior nonstructural wall partitions meeting criteria listed in exempt Item 3 for "Welding."
<input type="checkbox"/>	2. Concrete batch plant inspection is not required for items given in CBC Section 1705A.3.3.2 subject to the requirements and limitations in that section.
<input type="checkbox"/>	3. Non-bearing non-shear masonry walls may be exempt from certain DSA masonry testing and special inspection items as allowed per DSA IR 21-1. Refer to construction documents for specific exemptions accordingly for each applicable wall condition.
<input type="checkbox"/>	4. Epoxy shear dowels in site flatwork and/or other non-structural concrete.
<input type="checkbox"/>	5. Testing of reinforcing bars is not required for items given in CBC Section 1910A.2 subject to the requirements and limitations in that section.

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	Welding:
<input type="checkbox"/>	1. Solid-clad and open-mesh gates with maximum leaf span or rolling section for rolling gates of 10' and apex height less than 8'-0" above lowest adjacent grade. When located above circulation or occupied space below, these gates are not located within 1.5x gate/fence height (max 8'-0") to the edge of floor or roof.
<input type="checkbox"/>	2. Handrails, guardrails and modular or relocatable ramps associated with walking surfaces less than 30" above adjacent grade (excluding post base connections per the 'Exception' language in Section 1705A.2.1); fillet welds shall not be ground flush.
<input type="checkbox"/>	3. Non-structural interior cold-formed steel framing spanning less than 15'-0", such as in interior partitions, interior soffits, etc. supporting only self weight and light-weight finishes or adhered tile, masonry, stone, or terra cotta veneer no more than 5/8" thickness and apex less than 20'-0" in height and not over an exit way. Maximum tributary load to a member shall not exceed the equivalent of that occurring from a 10'x10' opening in a 15' tall wall for a header or king stud.
<input type="checkbox"/>	4. Manufactured support frames and curbs using hot rolled or cold-formed steel (i.e., light gauge) for mechanical, electrical, or plumbing equipment weighing less than 2000# (equipment only) (connections of such frames to superstructure elements using welding will require special inspection as noted in selected item(s) for Sections 19, 19.1 and/or 19.2 of listing above).
<input type="checkbox"/>	5. Manufactured components (e.g., Tolco, B-Line, Afcon, etc.) for mechanical, electrical, or plumbing hanger support and bracing (connections of such components to superstructure elements using welding will require special inspection as noted in selected item(s) for Sections 19, 19.1 and/or 19.2 of listing above).
<input type="checkbox"/>	6. TV Brackets, projector mounts with a valid listing (see DSA IR A-5) and recreational equipment (e.g., playground structures, basketball backstops, etc.) (connections of such elements to superstructure elements using welding will require special inspection as noted in selected item(s) for section 19, 19.1 and/or 19.2 located in the Steel/Aluminum category).
<input type="checkbox"/>	7. Any support for exempt non-structural components given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) meeting the following: A) when supported on a floor/roof, <400# and resulting composite center of mass (including component's center of mass) ≤4' above supporting floor/roof, B) when hung from a wall or roof/floor, <20# for discrete units or <5 plf for distributed systems.

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SIGNATURE), 2019 CBC

Application Number: 01-119056

School Name: Las Positas College

School District: Chabot-Las Positas
Community College District

DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

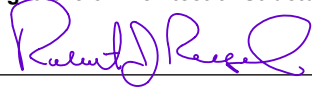
Name of Architect or Engineer in general responsible charge:

Anna Win

Name of Structural Engineer (When structural design has been delegated):

Robert J. Reigel

Signature of Architect or Structural Engineer:



Date:

11/16/2020

Note: To facilitate DSA electronic mark-ups and identification stamp application, DSA recommends against using secured electronic or digital signatures.

DSA STAMP	
IDENTIFICATION STAMP DIV. OF THE STATE ARCHITECT	
APP: 01-119056 INC:	
REVIEWED FOR	
SS <input checked="" type="checkbox"/>	FLS <input type="checkbox"/> ACS <input type="checkbox"/>
DATE: 01/19/2021	

DSA 103-19: LIST OF REQUIRED VERIFIED REPORTS, 2019 CBC

Application Number: 01-119056

School Name: Las Positas College

School District: Chabot-Las Positas
Community College District

DSA File Number: 1-C2

Increment Number:

Date Submitted: 7/7/2020

1. Soils Testing and Inspection: Geotechnical Verified Report Form DSA 293
2. Structural Testing and Inspection: Laboratory Verified Report Form DSA 291
3. Post-installed Anchors: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
4. Masonry Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
5. Shop Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
6. Field Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
7. High-Strength Bolt Installation Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292