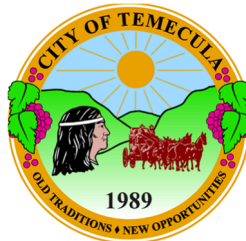




**CITY OF TEMECULA
DEPARTMENT OF PUBLIC WORKS
41000 Main Street
Temecula, California 92590
(951) 694-6411**



**PLANS, SPECIFICATIONS, AND CONTRACT DOCUMENTS
for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

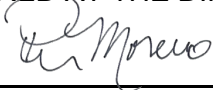
BID PACKET – OVER \$175,000

Revised June 19, 2024

**CITY OF TEMECULA
TEMECULA, CALIFORNIA
DEPARTMENT OF PUBLIC WORKS**

**PLANS, SPECIFICATIONS AND CONTRACT
DOCUMENTS
for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

PREPARED AT THE DIRECTION OF:



Ron Moreno, RCE #69156
Director of Public Works / City Engineer

APPROVED AS TO FORM:



Peter M. Thorson, City Attorney

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

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for

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PROJECT NO. PW19-13**

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CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

NOTICE INVITING BIDS

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

1. NOTICE IS HEREBY GIVEN that the City of Temecula, Riverside County, California, will receive **ELECTRONIC BIDS ONLY** up to **9:59:59 A.M.**, on **Wednesday, the 19th day of August, 2026**. The City of Temecula utilizes PlanetBids as its online bid management provider and location for public bid openings. Bids will be opened and the results of submitted **ELECTRONIC** bids for the subject project will be immediately available to the public at the stated date and time on the City's PlanetBids portal at:

<https://pbsystem.planetbids.com/portal/14837/portal-home>

Bids must be submitted **electronically** via the on-line bidding service PlanetBids. To download bid documents and to submit an electronic bid, a bidder must be registered with the City of Temecula as vendor. To register as a vendor, go to the following link, and then proceed to the "Register As A Vendor" link:

<http://temeculaca.gov/314/Purchasing-Contract-Administration>

Documents must be uploaded in PDF (Portable Document Format). Hard copies submitted to the City, in lieu of electronic copies uploaded onto the system, will not be accepted as a viable bid. It is the Bidder's responsibility to ensure that their bid documents are properly uploaded onto the City's online bid management system. Bids that are missing pages, cannot be opened, etc., may be considered unresponsive.

It is the bidder's sole responsibility to contact the City's online bid management provider (PlanetBids at 818-992-1771) to resolve any technical issues related to electronic bidding, including, but not limited to, registering as a vendor, updating passwords, updating profiles, uploading/downloading documents, submitting an electronic bid, etc.

Electronic bids must be received no later than the date and time specified above.

2. All of said work is to be performed in accordance with Plans and Specifications entitled **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**. These documents can be downloaded from PlanetBids. The charge for downloading bid documents is **\$75**.
3. The classification of Contractor's license required in the performance of this Contract is a Class **B**.
4. Pursuant to the provisions of Section 1773 of the Labor Code of the State of California, the City has obtained the general prevailing rate of per diem wages and the general prevailing rate for holiday and overtime work in this locality for each craft, classification or type of workman needed to execute the Contract from the Director of the Department of Industrial Relations. Copies may be obtained from the California Department of Industrial Relations website at: <http://www.dir.ca.gov>.
5. The successful bidder shall be required to furnish a Labor and Materials Bond and a Performance Bond in the amount of 100% of the amount of the Contract.

6. Pursuant to Section 22300 of the Public Contract Code of the State of California, the Contract will contain provisions permitting the successful bidder to substitute securities for any monies withheld by the City of Temecula to ensure performance under the Contract.
7. Each bidder must upload to PlanetBids the following documents ("Proposal") with his/her electronic bid prior to the date and time of the bid opening:
 - ☐ Bid Sheets
 - ☐ Subcontractors List / Bidders List
 - ☐ Statement of Technical Ability and Experience
 - ☐ Bidder's Statement of Past Contract Disqualifications
 - ☐ Non-Collusion Affidavit
 - ☐ Bidder's Agreement
 - ☐ Bid Bond

All bids shall be accompanied by **ONE** of the following forms of bidder's security:

- (1) A signed electronic bidder's bond by an admitted surety submitted via PlanetBids; OR
- (2) A signed bidder's bond by an admitted surety insurer received by the City at the address set forth below; OR
- (3) Cash, a cashier's check, or certified check received by and made payable to the City.

The required bidder's security shall be in an amount equal to at least 10% of the amount bid. A bid shall not be considered and will be deemed non-responsive unless one of the forms of bidder's security is enclosed with it.

If the bid security is delivered or mailed, the address is as follows:

City Clerk
City of Temecula
41000 Main Street
Temecula, CA 92590

The sealed bid security envelope must be marked as follows:

**BID SECURITY, DO NOT OPEN UNTIL BID OPENING
FIRE STATION 73 NEW APPARATUS BAY AND GYM,
PROJECT NO. PW19-13**

Bid securities mailed to the City's mailing address may or may not be delivered to the City Clerk on time. It is the responsibility of the prospective bidder to ensure that the City receives the bid security within the allotted time.

8. The work to be done consists of furnishing all materials, equipment, tools, labor, and incidentals as required by the Plans, Specifications, and Contract Documents for the above stated project. The general items of work to be done hereunder consist of:

Construction work generally consists of concrete demolition, construction of a new 897 square foot gym, a new 2,217 square foot apparatus bay & shop/storage building; the buildings include all accessibility improvements, construction materials, finishes, plumbing, mechanical, electrical, and related work. Exterior improvements include a concrete parking lot, storm drainpipe, lighting, new trash enclosure, and landscape & irrigation. Prior to any construction, the soils will need

to be improved with stone columns (or approved equal) per recommendations based on the soils report.

Project Address: 27415 Enterprise Cir W, Temecula, CA 92590

The Engineer's estimate for the proposed project is **\$4,035,000.**

The lowest responsible bid shall be determined by the lowest base bid. The City may elect to award any, none, or all of an additive bid(s) at its discretion.

Bidder's self-performance requirement is a minimum of 50% of the total bid.

9. The City Council reserves the right to reject any or all bids, to delete portions of the work, or to waive any defect or informality in any bid received.
10. All costs incurred by the selected bidder prior to Contract award and execution of the Contract by the City shall be at the bidder's sole risk. City shall have no liability for costs incurred prior to its execution of the Contract.
11. Questions pertaining to this project shall be directed to **William Becerra**, and **only submitted through the Planet Bids website.**

Dated: July 17, 2026



Randi Juhl, City Clerk

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

INSTRUCTIONS TO BIDDERS

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM

PROJECT NO. PW19-13

1. SECURING DOCUMENTS

Plans, Specifications and Contract Documents can be downloaded from PlanetBids. The charge for downloading bid documents is **\$75**.

To download bid documents and to submit an electronic bid, a bidder must be registered with the City of Temecula as vendor. To register as a vendor, go to the following link, and then proceed to the "Register as a Vendor" link.:

<http://temeculaca.gov/314/Purchasing-Contract-Administration>

2. PROPOSAL

To receive consideration, bids shall be made in accordance with the following instructions:

- a. Other than the Schedule of Prices, bids shall be made on the Proposal Forms contained herein. All items shall be properly filled in; numbers shall be stated both in writing and in figures. The signatures shall be in longhand. The completed forms shall be without alterations, interlineations, or erasures. The Proposal must be uploaded to PlanetBids after completing the required information. All items on the Schedule of Prices shall be completed **Electronically** in PlanetBids. Any bid item left blank in the **Electronic** Schedule of Prices in PlanetBids will deem the entire bid unresponsive and the bid will be disqualified. **DO NOT COMPLETE THE SCHEDULE OF PRICES INCLUDED IN THE BID SHEETS.**

Documents must be uploaded in PDF (Portable Document Format). It is the Bidder's responsibility to ensure that their bid documents are properly uploaded onto the City's online bid management system. Bids that are missing pages, cannot be opened, etc. may be considered unresponsive. It is the bidder's sole responsibility to contact the City's online bid management provider, PlanetBids at 818-992-1771, to resolve any technical issues related to electronic bidding, including, but not limited to, registering as a vendor, updating passwords, updating profiles, uploading/downloading documents, submitting an electronic bid, etc.

- b. Bids shall be submitted only on the items of bid stated in the Specifications; bids upon other basis will not be considered. Bids that do not reference all addenda or that are not submitted on the prescribed forms may be rejected.
- c. The City reserves the right to accept bids on work and alternatives listed in the bid form in sum total or individually or in any combination, unless the bid form makes specific provision to the contrary.
- d. Unless called for, alternative bids will not be considered.
- e. Modification of bids already submitted, will be considered if uploaded to PlanetBids by the time set for opening of bids.

- f. Pursuant to the provisions of Section 4100 through 4113 of the Public Contract Code of the State of California, every bidder shall, in the bid, set forth:
 - 1) The name and location of the place of business of each subcontractor who will perform work or labor or render service to the bidder in or about the work in an amount in excess of one-half of one percent of the bidder's total bid.
 - 2) The portion of the work which will be done by each such subcontractor.
- g. In the event that alternative bids are called for and bidder intends to use different or additional subcontractors on the alternative or alternatives, he shall fill out additional forms of the Subcontractors List and shall indicate on such forms whether they apply to the base or alternative bids.
- h. If the bidder fails to specify a subcontractor for any portion of the work to be performed under the Contract in excess of one-half of one percent of the bidder's total bid, he agrees to perform that portion himself. The successful bidder shall not, without the consent of the City, either:
 - 1) Substitute any person, firm, or corporation as subcontractor in place of the subcontractor designated in the original bid, or
 - 2) Permit any subcontract to be assigned or transferred or allow it to be performed by anyone other than the original subcontractor listed in the bid.
- i. All bids shall be accompanied by one of the following forms of bidder's security:
 - 1) A signed electronic bidder's bond by an admitted surety submitted via PlanetBids;
 - 2) A signed bidder's bond by an admitted surety insurer received by the City; or
 - 3) Cash, a cashier's check, or certified check received by, and made payable to, the City.
- j. The required bidder's security shall be in an amount equal to at least 10% of the amount bid. A bid shall not be considered and will be deemed non-responsive unless one of the forms of bidder's security is enclosed with it.
- k. Before submitting a bid, bidders shall carefully examine the Plans, Specifications, and Contract, shall visit the site of work, and shall fully inform themselves as to all existing conditions and limitations, and shall include in the bid a sum to cover the cost of all items included in the Contract.
- l. Bidders shall give unit prices for each and all of the items set forth. No aggregate bids will be considered. Any bid item left blank in the **Electronic** Schedule of Prices in PlanetBids will deem the entire bid unresponsive and the bid will be disqualified. The bidder shall set forth for each item of work a unit item price for the item in the respective spaces provided for this purpose. The PlanetBids system will automatically calculate the corresponding total for each unit price completed for each item in its respective space provided. The quantities listed in the Bid Sheets are supplied to give an indication of the general scope of work, but the accuracy of figures is not guaranteed and the bidder shall make his/her own estimates from the Plans and Specifications. In case of a variation between the unit price and the totals shown by the bidder, the unit price will be considered to be the bid.

- m. Bids and modifications thereof, if any, shall be delivered **Electronically** through PlanetBids on or before the day and hour set for the opening of bids in the Notice Inviting Bids.

3. MODIFICATIONS AFTER BID OPENING

A modification which is received from an otherwise successful bidder and which makes the terms of the bid more favorable to the City will be considered at any time it is received and may thereafter be accepted.

4. WITHDRAWAL OF BIDS

Bids may be withdrawn by written request received from bidders **Electronically** through PlanetBids **prior** to the time set for opening of bids.

5. INTERPRETATION OF PLANS AND SPECIFICATIONS

Should a bidder find discrepancies in, or omissions from the Plans or Specifications, or should he be in doubt as to their meaning, he shall at once notify the Project Manager. Should it be found that the point in question is not clearly and fully set forth, a written addendum will be sent to all persons receiving a set of documents. The City will not be responsible for any oral instructions.

6. ADDENDA OR BULLETINS

Any addenda or information issued during the time of bidding, or forming a part of the documents loaned to the bidder for the preparation of his/her bid, shall be covered in the bid and shall be made a part of the Contract.

7. OPENING BIDS

The City of Temecula utilizes PlanetBids as its online bid management provider and location for public bid openings. Bids will be opened and the results of submitted **ELECTRONIC** bids for the subject project will be immediately available to the public at the stated date and time on the City's PlanetBids portal at:

<https://pbsystem.planetbids.com/portal/14837/portal-home>

8. AWARD OR REJECTION OF BIDS

The City reserves the right to reject any and all bids, accept or reject alternates, and waive irregularities or informalities in the bid and bidding.

The award of the Contract, if it be awarded, will be to the lowest responsible bidder whose proposal complies with the requirements prescribed.

All bids will be compared on the basis of the Engineer's estimate of the quantities of work to be done.

9. BID PROTEST PROCEDURE

Pursuant to Chapter 3.32.090 of the City of Temecula Municipal Code, any actual or prospective bidder, proposer, or contractor (collectively "bidder") who believes he or she has been aggrieved in connection with the solicitation or award of a contract pursuant to this Chapter may protest, in writing, to the Office of the City Clerk, **within three (3) business days after posting of the award recommendation** at the location where bids

or proposals are submitted. The protest shall be deemed filed only when it is actually received by the Office of the City Clerk. Said bidder shall refer to Chapter 3.32.090 of the Temecula Municipal Code for detailed filing requirements. The City's Municipal Code can also be accessed online at:

<https://temeculaca.gov/260/Municipal-Code>

10. CONTRACT BONDS

- a. General. Within ten (10) days of the notice of award, the Contractor shall file with the Engineer surety bonds satisfactory to the City in the amounts and for the purposes noted below. Bonds shall be duly executed by an admitted corporate surety, authorized to issue such bonds in the State of California and secured through an authorized agent with an office in California. The Contractor shall pay all bond premiums, costs, and incidentals.

Each bond shall be signed by both the Contractor and surety, and the signature of the authorized agent of the surety shall be notarized.

The Contractor shall provide two good and sufficient surety bonds.

Surety companies shall familiarize themselves with all of the conditions and provisions of the Contract, and shall waive the right of special notification of change or modification of the Contract, or of any other act or acts by the City or its authorized agents under the terms of the Contract. Failure to notify the surety companies of change shall in no way relieve them of their obligations under the Contract.

- b. Labor and Materials Bond. The Labor and Materials Bond shall be for not less than 100% of the Contract price to satisfy claims of material suppliers and of mechanics and laborers employed by them on the work. The bond shall be maintained by the Contractor in full force and effect until the completed work is accepted by the City and until all claims for materials and labor are paid.
- c. Performance Bond. The Performance Bond shall be for 100% of the Contract price to guaranty faithful performance of all work, within the time prescribed in a manner satisfactory to the City, and that all materials and workmanship will be free from original or developed defects.
- d. Bond Renewal and Extension. Should any bond become insufficient, the Contractor immediately shall replace the bond with a substitute upon request from the City, and the effective date of the bond shall be from the commencement of work on the project.

Should any surety at any time be unsatisfactory to the City, notice will be given the Contractor to that effect. No further payment shall be deemed due or will be made under the Contract, until a new surety shall qualify and be accepted by the City.

Changes in the work or extension of time, made pursuant to the Contract, shall in no way release the Contractor or surety from their obligations. Notice of such changes or extensions shall be waived by the surety.

11. SPECIAL NOTICE

Bidders are required to inform themselves fully of the conditions relating to construction and labor under which the work will be performed, and the Contractor must employ, so far

as possible, such methods and means in the carrying out of its work as will not cause any interruption or interference with any other Contractor.

12. BIDDERS INTERESTED IN MORE THAN ONE BID

No person, firm, or corporation shall be allowed to make or file or be interested in more than one bid, as Prime Contractor for the same work. A person, firm, or corporation who has submitted a sub-proposal to a bidder, or who has quoted prices on materials to a bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other bidders.

13. BIDS TO BE LEFT ON DEPOSIT

Unless otherwise required by law, no bid, nor any part thereof, may be withdrawn by the bidder for a period of 90 calendar days after the opening of the bids.

14. MANDATORY NON-COLLUSION AFFIDAVIT

- a. The City will, before any award of the Contract is made, require any bidder to whom it may make an award of the principal Contract, to execute a Non-Collusion Affidavit.
- b. The City may require that the principal Contractor shall, before awarding any subcontract, secure from the proposed subcontractor a Non-Collusion Affidavit.

15. CONTRACTOR'S LICENSE

No bid may be considered from a Contractor who, at the time the bids are opened, is not licensed to perform the project in accordance with Division 3, Chapter 9 of the Business and Professions Code of the State of California. In the event of a dispute as to the classification of license required, the decision by the Contractors State License Board shall prevail. This requirement is not a mere formality, and it will not be waived by the City. The Classification of Contractor's license required in the performance of this Contract is a Class **B**.

16. PERMITS

The Contractor shall obtain and pay for all permits, including but not limited to Caltrans permits and City business licenses. The status of any permit applications processed during the design phase of the project is provided in Section 2-2 "Permits", of the Special Provisions.

17. PREVAILING WAGES

The Contractor is hereby notified that this project is subject to Federal and/or State prevailing wage guidelines as referenced in the Wage Rates and Labor Code Requirements sections of the Project Specifications. Where both Federal and State Guidelines are listed, the greater of the two listed general prevailing wages shall apply. The prime Contractor and all subcontractors are required to pay their laborers and mechanics employed under this Contract, a wage not less than the wage applicable for their work classification, as specified in the wage guidelines contained in the specifications.

18. REGISTRATION WITH THE DEPARTMENT OF INDUSTRIAL RELATIONS

Registration with the Department of Industrial Relations (DIR) is mandatory as a condition for bidding, providing certain services, and working on a public works project as specified in Labor Code Section 1771.1(a). Contractor and any subcontractors must be registered with the Department of Industrial Relations to be qualified to bid, or provide a proposal and/or time and material quote or be listed in a bid, proposal or quote, subject to the requirements of Public Contract Code Section 4104; or engage in the performance of any contract that is subject to Labor Code Section 1720 et seq., unless currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. Contractor and subcontractors will be required to provide proof of registration with the DIR. For more information regarding registration with the Department of Industrial Relations, refer to <http://www.dir.ca.gov/Public-Works/PublicWorks.html>

19. TIME LIMITS OF WORK

The work to be performed shall be completed within **ONE HUNDRED EIGHTY (180)** working days after execution of contract and Notice to Proceed has been issued.

20. WARRANTY

All work, except landscaping, shall be warranted for a period of one year. The warranty period shall start on the date the City Council approves the Notice of Completion for the work.. The Contractor shall promptly make all needed repairs arising out of defective materials, workmanship and equipment. Landscaping shall be guaranteed during the ninety-day maintenance period.

The City is hereby authorized to make such repairs if within ten days after giving written notice to the Contractor, or its agent, the Contractor should fail to make or undertake with due diligence the aforesaid repairs; provided, however, that in case of an emergency, where, in the opinion of the City, delay would cause serious loss or damage, repairs may be made without notice being sent to the Contractor, and the Contractor shall pay the costs thereof.

The Contractor shall, upon completion of the Contract and prior to filing of the Notice of Completion, post a Maintenance Bond in the amount of ten percent of the Contract value. The Maintenance Bond shall remain in full force and effect through the guaranty period of one year.

21. EXECUTION OF CONTRACT

After notification of a proposed contract award date, the successful bidder shall return two notarized copies of the contract with original signatures. The signed contract shall be returned to the City **at least twenty-one calendar days prior to the proposed contract award date**. The successful bidder shall then return the contract bonds and insurance **within ten working days of the date of the Notice of Award**.

22. ASSIGNMENT

The performance of the Contract may not be assigned, except upon the written consent of the Engineer. Consent will not be given to any proposed assignment which would relieve the original Contractor or its surety of their responsibilities under the Contract, nor will the Engineer consent to any assignment of a part of the work under the Contract.

23. CONTRACTOR'S INDEPENDENT INVESTIGATION

No plea of ignorance of conditions that exist, or that may hereafter exist, or of conditions or difficulties that may be encountered in the execution of the work under this Contract, as a result of failure on initial investigations or reports prepared by the City for purposes of letting this Contract out to bid, will be accepted as an excuse for any failure or omission on the part of the Contractor to fulfill in every detail all requirements of this Contract. Nor will such reasons be accepted as a basis for any claims whatsoever for extra compensation or for an extension of time.

24. SIGNATURE OF CONTRACTOR

Corporations: The signature must contain the name of the corporation, must be signed by at least two corporate officers, but must include the signature of the President. Other persons may sign for the corporation in lieu of the above if a certified copy of a Resolution of the Corporate Board of Directors so authorizing them to do so, is on file in the City Clerk's office.

Partnerships: The names of all persons comprising the partnership or co-partnership must be stated. The bid must be signed by all partners comprising the partnership unless proof in the form of a certified copy of a certificate of partnership acknowledging the signer to be a general partner is presented to the City Clerk, in which case the General Partner may sign.

Joint Ventures: Bids submitted as joint ventures must so state and be signed by each joint venturer.

Individuals: Bids submitted by individuals must be signed by the bidder, unless an up-to-date power of attorney is on file in the City Clerk's office, in which case said person may sign for individual.

25. SUBSTITUTED SECURITY

In accordance with Section 22300 of the Public Contracts Code, Contractor may substitute securities for any monies withheld by the City to insure performance under the Contract. At the request and expense of the Contractor, securities equivalent to the amount withheld shall be deposited with the City or with a State or Federally chartered bank, or an escrow agent, who shall pay such monies to the Contractor upon notification by City of Contractor's satisfactory completion of the Contract. The type of securities deposited and the method of release shall be approved by the City Attorney's office.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

CONTRACT

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM

PROJECT NO. PW19-13

THIS CONTRACT, made and entered into the **DATE, 2024** by and between the City of Temecula, a municipal corporation, hereinafter referred to as "City", **Company Inc.**, hereinafter referred to as "Contractor."

WITNESSETH:

That City and Contractor, for the consideration hereinafter named, mutually agree as follows:

1. **CONTRACT DOCUMENTS**

The complete Contract includes all of the Contract Documents, to wit: Notice Inviting Bids, Instructions to Bidders, Proposal, Performance Bond, Labor and Materials Bond, Plans and Specifications entitled **NAME OF PROJECT, PROJECT NO. PW**, Insurance Forms, this Contract, and all modifications and amendments thereto, the State of California Standard Plans and Specifications, (latest edition), issued by the California Department of Transportation, where specifically referenced in the Plans, Special Provisions, and Technical Specifications, and the latest version of the Standard Specifications for Public Works Construction, including all supplements as written and promulgated by Public Works Standards, Inc. (hereinafter, "Standard Specifications") as amended by the General Specifications, Special Provisions, and Technical Specifications for **NAME OF PROJECT, PROJECT NO. PW**. Copies of these Standard Specifications are available from the publisher:

BNi Building News
Division of BNi Publications, Inc.
990 Park Center Drive, Suite E
Vista, CA 92081
(760) 734-1113

The Standard Specifications will control the general provisions, construction materials, and construction methods for this Contract except as amended by the General Specifications, Special Provisions, and Technical Specifications for **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**.

If there is a conflict between any of the Contract Documents, the document highest in the order of precedence shall control. The order of precedence, from highest to lowest, shall be as follows:

- a) Permits issued by jurisdictional regulatory agencies.
- b) Change Orders and Supplemental Agreements; whichever occurs last.
- c) Contract/Agreement.
- d) Addenda.
- e) Bid/Proposal.
- f) Special Provisions.

- g) Plans.
- h) Standard Plans.
- i) Standard Specifications.
- j) Reference Specifications.

Detail drawings shall take precedence over general drawings. The precedence of the notice inviting bids and instructions to bidders shall be as specified in the Special Provisions.

Where the Contract Documents describe portions of the work in general terms, but not in complete detail, it is understood that the item is to be furnished and installed completed and in place and that only the best general practice is to be used. Unless otherwise specified, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract.

The Contract Documents are complementary, and what is called for by anyone shall be as binding as if called for by all. Any conflict between this Contract and any other Contract Document shall be resolved in favor of this Contract.

2. SCOPE OF WORK

Contractor shall perform everything required to be performed, shall provide and furnish all the labor, materials, necessary tools, expendable equipment, and all utility and transportation services required for the following: **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13.**

All of said work to be performed and materials to be furnished shall be in strict accordance with the Drawings and Specifications and the provisions of the Contract Documents hereinabove enumerated and adopted by City.

3. CITY APPROVAL

All labor, materials, tools, equipment, and services shall be furnished and work performed and completed under the direction and supervision, and subject to the approval of City or its authorized representatives.

4. CONTRACT AMOUNT AND SCHEDULE

The City agrees to pay, and Contractor agrees to accept, in full payment for, the work agreed to be done, the sum of: **DOLLARS AND ZERO CENTS (\$)**, the total amount of the base bid.

Contractor agrees to complete the work in a period not to exceed **One Hundred Eighty (180) working days**, commencing with delivery of a Notice to Proceed by City. Construction shall not commence until bonds and insurance are approved by City.

5. CHANGE ORDERS

All change orders shall be approved by the City Council, except that the City Manager is hereby authorized by the City Council to make, by written order, changes or additions to the work in an amount not to exceed the contingency as established by the City Council.

6. PAYMENTS

a. Lump Sum Bid Schedule: Before submittal of the first payment request, the Contractor shall submit to the Director of Public Works a schedule of values allocated to the various portions of the work, prepared in such form and supported by such data to substantiate its accuracy as the Director of Public Works may require. This schedule, as approved by the Director of Public Works, shall be used as the basis for reviewing the Contractor's payment requests.

b. Unit Price Bid Schedule: Pursuant to Section 20104.50 of the Public Contract Code, within 30 days after submission of a payment request to the City, the Contractor shall be paid a sum equal to **95% of the value of the work** completed according to the bid schedule. Payment request forms shall be submitted on or about the 30th day of each successive month as the work progresses. The final payment, if unencumbered, or any part thereof unencumbered, shall be made 60 days after acceptance of final payment and the Contractor filing a one-year Warranty and an Affidavit of Final Release with the City on forms provided by the City.

c. Payment for Work Performed: Payments shall be made on demands drawn in the manner required by law, accompanied by a certificate signed by the City Manager, stating that the work for which payment is demanded has been performed in accordance with the terms of the Contract, and that the amount stated in the certificate is due under the terms of the Contract. Partial payments on the Contract price shall not be considered as an acceptance of any part of the work.

d. Payment of Interest: Interest shall be paid on all undisputed payment requests not paid within 30 days pursuant to Public Contract Code Section 20104.50. Public Contract Code Section 7107 is hereby incorporated by reference.

7. LIQUIDATED DAMAGES / EXTENSION OF TIME

a. Liquidated Damages: In accordance with Government Code Section 53069.85, Contractor agrees to forfeit and pay to City the sum of \$1,000 per day for each calendar day completion is delayed beyond the time allowed pursuant to Paragraph 4 of this Contract. Such sum shall be deducted from any payments due to or to become due to Contractor.

b. Extension of Time: Contractor will be granted an extension of time and will not be assessed liquidated damages for unforeseeable delays beyond the control of, and without the fault or negligence of the Contractor, including delays caused by City. Within ten calendar days of the occurrence of such delay, Contractor shall give written notice to City. Within 30 calendar days of the occurrence of the delay, Contractor shall provide written documentation sufficient to support its delay claim to City. Contractor's failure to provide such notice and documentation shall constitute Contractor's waiver, discharge, and release of such delay claims against City.

8. WAIVER OF CLAIMS

On or before making each request for payment under Paragraph 6 above, Contractor shall submit to City, in writing, all claims for compensation as to work related to the payment. Unless the Contractor has disputed the amount of the payment, the acceptance by Contractor of each payment shall constitute a release of all claims against the City related to the payment. Contractor shall be required to execute an affidavit, release, and indemnity agreement with each claim for payment.

9. PREVAILING WAGES

Pursuant to the provisions of Section 1773 of the Labor Code of the State of California, the City Council has obtained the general prevailing rate of per diem wages and the general rate for holiday and overtime work in this locality for each craft, classification, or type of workman needed to execute this Contract from the Director of the Department of Industrial Relations. Copies may be obtained from the California Department of Industrial Relations Internet website at <http://www.dir.ca.gov>. Contractor shall provide a copy of prevailing wage rates to any staff or subcontractor hired, and shall pay the adopted prevailing wage rates as a minimum. Contractor shall comply with the provisions of Sections 1720, 1720.9, 1725.5, 1771.1(a), 1773.8, 1775, 1776, 1777.5, 1777.6, and 1813 of the Labor Code. Pursuant to the provisions of 1775 of the Labor Code, Contractor shall forfeit to the City, as a penalty, the sum of \$200.00 for each calendar day, or portion thereof, for each laborer, worker, or mechanic employed, paid less than the stipulated prevailing rates for any work done under this Contract, by him or by any subcontractor under him, in violation of the provisions of the Contract. This project, work, or service will be subject to

compliance monitoring and enforcement by the Department of Industrial Relations (DIR) pursuant to Labor Code Section 1771.4.

10. TIME OF THE ESSENCE

Time is of the essence in this contract.

11. INDEMNIFICATION

All work covered by this Contract done at the site of construction or in preparing or delivering materials to the site shall be at the risk of Contractor alone. Contractor agrees to save, indemnify, hold harmless and defend the City of Temecula, Temecula Community Services District, and/or Successor Agency to the Temecula Redevelopment Agency, its officers, employees, and agents, against any and all liability, injuries, or death of persons (Contractor's employees included), and damage to property, arising directly or indirectly out of the obligations herein undertaken or out of the operations conducted by Contractor, save and except claims or litigations arising through the sole active negligence or sole willful misconduct of the City.

The Contractor shall indemnify and be responsible for reimbursing the City for any and all costs incurred by the City as a result of Stop Notices filed against the project. The City shall deduct such costs from progress payments or final payments due to the Contractor.

12. GRATUITIES

Contractor warrants that neither it nor any of its employees, agents, or representatives has offered or given any gratuities or promises to City's employees, agents, or representatives with a view toward securing this Contract or securing favorable treatment with respect thereto.

13. CONFLICT OF INTEREST

Contractor warrants that none of its partners, members or shareholders are related by blood or marriage to any employee of the City who has participated in the development of the specifications or approval of this project or who will administer this project nor are they in any way financially associated with any City officer or employee, or any architect, engineer, or other preparers of the Drawings and Specifications for this project. Contractor further warrants that no person in its employ nor any person with an ownership interest in the Contractor has been employed by the City within one year of the date of the Notice Inviting Bids.

14. CONTRACTOR'S AFFIDAVIT

After the completion of the work contemplated by this Contract, Contractor shall file with the City Manager, its affidavit stating that all workmen and persons employed, all firms supplying materials, and all subcontractors upon the Project have been paid in full, and that there are no claims outstanding against the Project for either labor or materials, except certain items, if any, to be set forth in an affidavit covering disputed claims or items in connection with a Stop Notice which has been filed under the provisions of the laws of the State of California.

15. NOTICE TO CITY OF LABOR DISPUTES

Whenever the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of the Contract, Contractor shall immediately give notice thereof, including all relevant information with respect thereto, to City.

16. BOOKS AND RECORDS

Contractor's books, records, and plans or such part thereof as may be engaged in the performance of this Contract, shall at all reasonable times be subject to inspection and audit by any authorized representative of the City.

17. INSPECTION

The work shall be subject to inspection and testing by City and its authorized representatives during manufacture and construction and all other times and places, including without limitation, the plants of Contractor and any of its suppliers. Contractor shall provide all reasonable facilities and assistance for the safety and convenience of inspectors. All inspections and tests shall be performed in such manner as to not unduly delay the work. The work shall be subject to final inspection and acceptance notwithstanding any payments or other prior

inspections. Such final inspection shall be made within a reasonable time after completion of the work.

18. DISCRIMINATION

Contractor represents that it has not, and agrees that it will not, discriminate in its employment practices on the basis of race, creed, religion, national origin, color, sex, age, or handicap.

19. GOVERNING LAW

The City and Contractor understand and agree that the laws of the State of California shall govern the rights, obligations, duties and liabilities of the parties to this Contract and also govern the interpretation of this Contract.

20. PROHIBITED INTEREST

No member, officer, or employee of the City of Temecula or of a local public body who has participated in the development of the specifications or approval of this project or will administer this project shall have any interest, direct or indirect, in the Contract or the proceeds thereof during his/her tenure or for one year thereafter.

Furthermore, the Contractor covenants and agrees to their knowledge that no board member, officer or employee of the City of Temecula has any interest, whether contractual, non-contractual, financial or otherwise, in this transaction, or in the business of the contracting party other than the City of Temecula, and that if any such interest comes to the knowledge of either party at any time, a full and complete disclosure of all such information will be made, in writing, to the other party or parties, even if such interest would not be considered a conflict of interest under Article 4 (commencing with Section 1090) or Article 4.6 (commencing with Section 1220) of Division 4 of Title I of the Government Code of the State of California.

21. ADA REQUIREMENTS

By signing this Contract, Contractor certifies that the Contractor is in total compliance with the Americans with Disabilities Act of 1990, Public Law 101-336, as amended.

22. WRITTEN NOTICE

Any written notice required to be given in any part of the Contract Documents shall be performed by depositing the same in the U.S. Mail, postage prepaid, directed to the address of the Contractor as set forth in the Contract Documents, and to the City addressed as follows:

Mailing and Delivery Address: Ron Moreno
Director of Public Works / City Engineer
City of Temecula
41000 Main Street
Temecula, CA 92590

23. INSURANCE

Contractor shall procure and maintain for the duration of the contract insurance against claims for injuries to persons and/or damages to property, which may arise from or in connection with the performance of the work hereunder and the results of work by the Contractor, its agents, representatives, employees, or subcontractors.

a. Minimum Scope of Insurance. Coverage shall be at least as broad as:

1) Commercial General Liability (CGL): Insurance Services Office Form CG 00 01 covering CGL on an "occurrence" basis, including products and completed operation, property damage, bodily injury, and personal & advertising with limits no less than Two Million (\$2,000,000) per occurrence. If a general aggregate limit applies, either the general

aggregate limit shall apply separately to this project/location (ISO CG 25 03 05 09 or 25 04 05 09) or the general aggregate limit shall be twice the required occurrence limit.

2) Automobile Liability: ISO Form Number CA 00 01 covering any auto (Code 1), or if Contractor has no owned autos, covering hired, (Code 8) and non-owned autos (Code 9), with limits no less than One Million (\$1,000,000) per accident for bodily injury, including death, of one or more persons, property damage and personal injury.

3) Workers' Compensation: as required by the State of California, with Statutory Limits, and Employer's Liability Insurance with limit of no less than One million (\$1,000,000) per accident for bodily injury or disease. In accordance with the provisions of Labor Code Section 3700, every contractor will be required to secure the payment of compensation to its employees. Pursuant to Labor Code Section 1861, Vendor must submit to City the following certification before beginning any work on the Improvements:

I am aware of the provisions of Section 3700 of the Labor Code which 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 the work of this contract.

By executing this Agreement, Vendor is submitting the certification required above.

The policy must contain a waiver of subrogation in favor of the City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

b. Deductibles and Self-Insured Retentions. Any deductibles or self-insured retentions must be declared and approved by the Risk Manager.

c. Other Insurance Provisions. The insurance policies are to contain, or be endorsed to contain, the following provisions:

1) The City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees and volunteers are to be covered as additional insureds on the CGL policy with respect to liability arising out of work or operations performed by or on behalf of the Contractor's products and completed operations of the Contractor; premises owned, occupied or used by the Contractor. General liability coverage can be provided in the form of an endorsement to the Contractor Insurance (at least as broad as ISO Form CG 20 10 11 85 or if not available, through the addition of both CG 20 10, CG 20 26, CG 20 33, or CG 20 38; and CG 20 37 if a later edition is used). The coverage shall contain no special limitations on the scope of protection afforded to the City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

2) For any claims related to this project, the Contractor insurance coverage shall be primary and non-contributory and at least as broad as ISO CG 20 01 04 13 as respects the City, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the City of Temecula, Temecula Community Services District, and/or the Successor Agency to the Temecula Redevelopment Agency, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it. This also applies to any Excess or Umbrella liability policies.

3) The Contractor may use Umbrella or Excess Policies to provide the limits as required in this agreement. The Umbrella or Excess policies shall be provided on a true

“following form” or broader coverage basis, with coverage at least as broad as provided on the underlying Commercial General Liability Insurance.

4) Any failure to comply with reporting or other provisions of the policies including breaches of warranties shall not affect the indemnification provided to the City of Temecula, the Temecula Community Services District, and/or the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

5) The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

6) If the Contractor's maintains broader coverage and/or higher limits than the minimums shown above, the City requires and shall be entitled to the broader coverage and/or higher limits maintained by the contractor.

7) If insurance coverage is canceled or, reduced in coverage or in limits the Contractor shall within two (2) business days of notice from insurer phone, fax, and/or notify the City via certified mail, return receipt requested of the changes to or cancellation of the policy.

8) Unless otherwise approved by City, if any part of the Services and Tasks is subcontracted, the Minimum Insurance Requirements must be provided by, or on behalf of, all subcontractors even if city has approved lesser insurance requirements for Contractor, and all subcontractors must agree in writing to be bound by the provisions of this section.

d. Acceptability of Insurers. Insurance required above, except for workers' compensation insurance, must be placed with insurers with a current A.M. Best rating of A-: VII or better, unless otherwise acceptable to the City. Self-insurance shall not be considered to comply with these insurance requirements.

e. Verification of Coverage. Contractor shall furnish the City with original certificates and amendatory endorsements, or copies of the applicable policy language affecting coverage required by this clause. All certificates and endorsements and copies of the Declarations & Endorsements pages are to be received and approved by the City before work commences. However, failure to obtain the required documents prior to the work beginning shall not waive the Contractor obligation to provide them. The City reserves the right to require complete, certified copies of all required insurance policies, including endorsements required by these specifications, at any time.

f. Special Risks or Circumstances. The City reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

24. RECOVERED MATERIALS AND SOLID WASTE DISPOSAL ACT

Contractor agrees to comply with all requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including but not limited to the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

25. TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Contractor shall not procure or obtain, extend or renew a contract to procure or obtain, or enter into a contract to procure or obtain equipment, services, or systems that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation, or any subsidiary or affiliate of such entities. Covered equipment also includes video surveillance and telecommunications equipment or services provided by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, Dahua Technology Company, any subsidiary or affiliate of such entities,

and any entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

26. COMPLIANCE WITH LAWS

The Contractor shall comply with all applicable federal, State and local laws, ordinances, codes and regulations in force at the time the Contractor performs pursuant to the Contract Documents, and shall comply with all grant or funding terms and conditions applicable to the Contract and/or the work.

27. CLAIM DISPUTE RESOLUTION

In the event of any dispute or controversy with the City over any matter whatsoever, the Contractor shall not cause any delay or cessation in or of work, but shall proceed with the performance of the work in dispute. The Contractor shall retain any and all rights provided that pertain to the resolution of disputes and protests between the parties. The disputed work will be categorized as an "unresolved dispute" and payment, if any, shall be as later determined by mutual agreement or a court of law. The Contractor shall keep accurate, detailed records of all disputed work, claims and other disputed matters.

All claims arising out of or related to the Contract or this project, and the consideration and payment of such claims, are subject to the Government Claims Act (Government Code Section 810 et seq.) with regard to filing claims. All such claims are also subject to Public Contract Code Section 9204 and Public Contract Code Section 20104 et seq. (Article 1.5), where applicable. This Contract hereby incorporates those provisions as though fully set forth herein. Thus, the Contractor or any Subcontractor must present a claim in accordance with the Government Claims Act as a prerequisite to prosecuting any claim against the City. The filing or prosecution of a claim in compliance with Section 9204 and/or Article 1.5 (if applicable) does not in any way obviate the need to timely present a claim under the Government Claims Act, or in any toll the expiration of any limitations period for the timely presentation of a claim under the Government Claims Act.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be executed on the date first above written.

DATED: _____

CONTRACTOR:

Inc.

Address

City, State, Zip

(951)

Email

By: _____

Print or type NAME

Print or type TITLE*

By: _____

Print or type NAME

Print or type TITLE*

(*Signatures of two corporate officers required for Corporations)

CITY OF TEMECULA

DATED: _____

By: _____

Jessica Alexander, Mayor

ATTEST:

Randi Johl, City Clerk

APPROVED AS TO FORM:

Peter M. Thorson, City Attorney

Risk Mgmt. _____

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BOND NO. _____

LABOR AND MATERIALS BOND

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

KNOW ALL PERSONS BY THESE PRESENTS:

THAT, WHEREAS, the City of Temecula has awarded to:

NAME AND ADDRESS OF CONTRACTOR

(hereinafter called "Contractor"), a contract for the work described as follows: **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13** (hereinafter called "Contract"), and

WHEREAS, said Contractor is required by the provisions of Sections 9550 through 9566 of the Civil Code to furnish a bond in connection with said Contract, as hereinafter set forth.

NOW, THEREFORE, WE, the undersigned Contractor, as Principal, and

NAME AND ADDRESS OF SURETY

are duly authorized to transact business under the laws of the State of California, as Surety (hereinafter called "Surety"), are held and firmly bound unto the City of Temecula, California, and all contractors, subcontractors, laborers, material men, and other persons employed in the performance of the aforesaid Contract and referred to in Section 9100 of the Civil Code, in the penal sum of _____ **DOLLARS AND** _____ **CENTS (\$_____)**, lawful money of the United States, said sum being not less than 100% of the estimated amount payable by the said City of Temecula under the terms of the Contract, for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that, if said Contractor, or its heirs, executors, administrators, successors, and assigns, or subcontractors, shall fail to pay for any materials, provisions, provender or other supplies, or teams, implements or machinery, used in, upon, for, or about the performance of the work under the Contract to be done, or for any work or labor thereon of any kind or for amounts due under Section 13020 of the Unemployment Insurance Code with respect to such work or labor, as required by Section 9550 et seq. of the Civil Code, and provided that the claimant shall have complied with the provisions of said Civil Code, the Surety shall pay for the same in an amount not exceeding the sum specified in this bond, otherwise the above obligation shall be void.

As a part of the obligation secured hereby and in addition to the face amount specified, costs and reasonable expenses and fees shall be included, including reasonable attorneys' fees incurred by the City of Temecula in successfully enforcing this obligation, all to be taxed as costs and included in any judgment rendered.

This bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under Section 9100 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond, and shall also cover payment for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Contractor or its subcontractors pursuant to Section 13020 of the Unemployment Insurance Code.

The Surety hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or to the work to be performed thereunder, or to the specifications accompanying the same, shall in any way affect its obligations on this bond. The Surety hereby waives notice of any such change, extension of time, alteration, or addition to the terms of the Contract, or to the work to be performed thereunder, or to the specifications accompanying the same.

IN WITNESS WHEREOF, this instrument has been duly executed by the Principal and Surety above named, on this _____ day of _____, 20_____.

(Seal)

SURETY:

By: _____

(Name)

(Title)

PRINCIPAL:

By: _____

(Name)

(Title)

By: _____

APPROVED AS TO FORM:

(Name)

Peter M. Thorson, City Attorney

(Title)

NOTE: Signatures of two corporate officers required for corporations. A Notarial Acknowledgement or Jurat must be attached for each of the Surety and Principal Signatures.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BOND NO. _____

PERFORMANCE BOND

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

KNOW ALL PERSONS BY THESE PRESENTS:

THAT, WHEREAS, the City of Temecula, State of California, entered into a Contract on this _____ day of _____, 20____, hereinafter called "Contract," with

NAME AND ADDRESS OF CONTRACTOR

(hereinafter called "Principal"), for the work described as follows: **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**; and

WHEREAS, the said Principal is required under the terms of said Contract to furnish a bond for the faithful performance of said Contract.

NOW, THEREFORE, WE, the Principal, and

NAME AND ADDRESS OF SURETY

are duly authorized to transact business under the laws of the State of California, as Surety (hereinafter called "Surety"), are held and firmly bound unto the City of Temecula in the penal sum of _____ **DOLLARS AND** _____ **CENTS (\$_____)**, lawful money of the United States, for the payment of which sum we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that, if the Principal, its heirs, executors, administrators, successors, or assigns, shall in all things stand to, abide by, and well and truly keep and perform the covenants, conditions and agreements in the said Contract, and in any alteration thereof made as therein provided, on its part to be kept and performed, at the time and in the manner therein specified, in all respects according to their true intent and meaning, and shall indemnify and save harmless the City of Temecula, its officers and agents, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

As a part of the obligation secured hereby and in addition to the face amount specified, costs and reasonable expenses and fees shall be included, including reasonable attorneys' fees incurred by the City of Temecula in successfully enforcing this obligation, all to be taxed as costs and included in any judgment rendered.

The Surety hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or to the work to be performed thereunder, or to the specifications accompanying the same, shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract, or to the work, or to the Specifications.

IN WITNESS WHEREOF, this instrument has been duly executed by the Principal and Surety above named, on this _____ day of _____, 20_____.

(Seal)

SURETY:

By: _____

(Name)

(Title)

PRINCIPAL:

By: _____

(Name)

(Title)

By: _____

(Name)

(Title)

APPROVED AS TO FORM:

Peter M. Thorson, City Attorney

NOTE: Signatures of two corporate officers required for corporations. A Notarial Acknowledgement or Jurat must be attached for each of the Surety and Principal Signatures.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BOND NO. _____

MAINTENANCE BOND

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

KNOW ALL PERSONS BY THESE PRESENT THAT

NAME AND ADDRESS OF CONTRACTOR

a _____ (hereinafter called "Principal"), and
(fill in whether a Corporation, Partnership, or Individual)

NAME AND ADDRESS OF SURETY

(hereinafter called "Surety"), are held and firmly bound unto CITY OF TEMECULA (hereinafter called "Owner") in the penal sum of _____ **DOLLARS AND _____ CENTS (\$_____)** in lawful money of the United States, said sum being not less than ten percent of the Contract value payable by the said City of Temecula under the terms of the Contract, for the payment of which, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain Contract with the Owner, dated the _____ **day of _____, 20____**, a copy of which is hereto attached and made a part hereof for the construction of **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**.

WHEREAS, said Contract provides that the Principal will furnish a bond conditioned to guarantee for the period of one year starting on the date the City Council approved the Notice of Completion for the said job, by the Owner, against all defects in workmanship and materials which may become apparent during said period; and

WHEREAS, the said Contract has been completed, and the Notice of Completion was approved by City Council on this the _____ **day of _____, 20____**.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if within one year from the date of approval of the final estimate on said job pursuant to the Contract, the work done under the terms of said Contract shall disclose poor workmanship in the execution of said work, and the carrying out of the terms of said Contract, or it shall appear that defective materials were furnished thereunder, then this obligation shall remain in full force and virtue, otherwise this instrument shall be void.

As a part of the obligation secured hereby and in addition to the face amount specified, costs and reasonable expenses and fees shall be included, including reasonable attorney's fees incurred

by the City of Temecula in successfully enforcing this obligation, all to be taxed as costs and included in any judgment rendered.

The Surety hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or to the work to be performed thereunder, or to the specifications accompanying the same, shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract, or to the work, or to the Specifications.

Signed and sealed this _____ day of _____, 20_____.

(Seal)

SURETY:

By: _____

(Name)

(Title)

PRINCIPAL:

By: _____

(Name)

(Title)

By: _____

(Name)

(Title)

APPROVED AS TO FORM:

Peter M. Thorson, City Attorney

NOTE: Signatures of two corporate officers required for corporations. A Notarial Acknowledgement or Jurat must be attached for each of the Surety and Principal Signatures.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

CONTRACTOR'S AFFIDAVIT AND FINAL RELEASE

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

This is to certify that _____,
(hereinafter the "Contractor") declares to the City of Temecula, under oath, that he/she/it has paid in full for all materials, supplies, labor, services, tools, equipment, and all other bills contracted for by the Contractor or by any of the Contractor's agents, employees or subcontractors used or in contribution to the execution of its Contract with the City of Temecula, with regard to the building, erection, construction, or repair of that certain work of improvement known as **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**, situated in the City of Temecula, State of California, more particularly described as follows:

ADDRESS OR DESCRIBE LOCATION OF WORK

The Contractor declares that it knows of no unpaid debts or claims arising out of said Contract which would constitute grounds for any third party to claim a Stop Notice against of any unpaid sums owing to the Contractor.

Further, in connection with the final payment of the Contract, the Contractor hereby disputes the following amounts:

<u>Description</u>	<u>Dollar Amount to Dispute</u>

Pursuant to Public Contract Code Section 7100, the Contractor does hereby fully release and acquit the City of Temecula and all agents and employees of the City, and each of them, from any and all claims, debts, demands, or cause of action which exist or might exist in favor of the Contractor by reason of payment by the City of Temecula of any contract amount which the Contractor has not disputed above.

CONTRACTOR:

Dated: _____

By: _____
Signature

Print Name and Title

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

PROPOSAL

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

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CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BID SHEETS

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

TO THE CITY CLERK OF TEMECULA, CALIFORNIA

DATE: _____

BIDDER:

Contact: _____

Firm Name: _____

Address: _____

Phone: _____

Email: _____

The undersigned hereby proposes and agrees to furnish any and all materials, labor, and services for the following: **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**

All in accordance with Plans and Specifications on file at the office of the City Clerk, City of Temecula.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BID SHEETS (continued)
SCHEDULE OF PRICES – BASE BID

for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

ITEM NO.	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED AMOUNT
1	Construction of Fire Station 73 Apparatus Bay and Gym	LS	1	ENTER TOTALS, SIGN, DATE AND PROVIDE OTHER REQUIRED INFORMATION ON PROPOSAL SHEETS PRIOR TO UPLOADING TO PLANETBIDS	BIDDERS: PLEASE COMPLETE ELECTRONIC SCHEDULE OF PRICES IN PLANETBIDS ONLY
2(S)	Remove and Replace Landscape	LS	1		
3(S)	Remove and Replace Irrigation	LS	1		
4(S)	Civil Construction	LS	1		
5(S)	Soil Improvement	LS	1		

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BID SHEETS (continued)
TOTAL AMOUNT OF BASE BID

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

TOTAL AMOUNT OF BID: _____

_____ DOLLARS AND _____ CENTS (\$_____).

The undersigned hereby certifies that he/she has an appropriate license, issued by the State of California to provide this work; that such license will be in full force and effect throughout the duration of construction; and that any and all subcontractors to be employed on this project will be similarly licensed.

Dated: _____

CONTRACTOR:

California Contractor's License No.

Signature

Print or Type Name

Print or Type Title

The bid proposal includes Addenda No's _____.

REJECTION OF BIDS: The undersigned agrees that the City of Temecula reserves the right to reject any or all bids, and reserves the right to waive informalities in a bid or bids not affected by law, if to do so seems to best serve the public interest.

TIME: If the proposal is accepted, the undersigned agrees to execute the required agreement and furnish the required bonds within ten working days from the date of award of this Contract.

BID DEPOSIT: There is enclosed herewith, a certified check or surety bond in the sum of ten percent of the base bid; _____ **Dollars and** _____ **Cents (\$_____)**, made payable to the City of Temecula, and the undersigned agrees that in case of his/her failure to execute the necessary contract and furnish the required bonds, the certified check or surety bond, the money payable thereon, shall be and remain the property of the City of Temecula.

NOTE: The estimated quantities listed in the proposal Bid Sheets are supplied to give an indication of the general scope of work, but the accuracy of these figures is not guaranteed and Bidder shall make his/her own estimates from the drawings. In case of a variation between the Unit Price and the Extended Amount, the Unit Price will be used to calculate the Extended Amount.

The unit price or lump sum prices to be paid for the items listed in the proposal Bid Sheets shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all work involved in furnishing and installing the materials complete and in place, in accordance with the details as shown on the Plans and as specified herein. Any items shown on the Plans, but not included in the bid items, shall be considered as appurtenant items. All costs shall be included within the various items of the Contractor's bid.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS
SUBCONTRACTORS LIST / BIDDERS LIST
for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

PRIME CONTRACTOR: _____

As required by California State Law and in conformance with Title 49 of US Code of Regulations, Part 26, the General Contractor bidding will hereinafter state the subcontractor who will be the subcontractor on the job for each particular trade or subdivision of the work. **ALL SUBCONTRACTORS REGARDLESS OF DOLLAR VALUE SHALL BE LISTED.** The General Contractor shall state the firm name and principal location of the mill, shop, or office of each. If a General Contractor fails to specify a subcontractor, or if the General Contractor specifies more than one subcontractor for the same portion of work to be performed under the Contract in excess of one-half of one percent, the General Contractor agrees that it is fully qualified to perform that portion and that it shall perform that portion.

REGISTRATION WITH THE DEPARTMENT OF INDUSTRIAL RELATIONS. The Bidder's attention is directed to Labor Code Section 1725.5, which provides that a contractor or subcontractor shall not be qualified to bid on, be listed in a Bid proposal, subject to the requirements of Public Contract Code Section 4104, or engage in the performance of any contract that is subject to Labor Code Section 1720 et seq., unless currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

DIVISION OF WORK OR TRADE	BID ITEM NUMBER	PERCENT OF BID ITEM	NAME & ADDRESS OF SUBCONTRACTOR	LICENSE NO. OF SUBCONTRACTOR /DIR REGISTRATION NO.	LAST YEAR'S GROSS RECEIPTS (a)	PERCENT OF TOTAL BID

Notes: (1) Used on Federal-aid contracts in conformance with Title 49 CFR 26. Indicate approximate amount if under \$1 million, if between \$1 million and \$5 million, if greater than \$5 million. (2) If alternate bids are called for, and Contractor intends to use different or additional subcontractors on the alternates, the Contractor must provide a separate list of subcontractors for each alternate. (3) Copies of this form may be made if necessary.

Signature of Bidder

The Bidder is required to state what work of a similar character to that included in the proposed Contract he/she has successfully performed, especially for public agencies, and give references which will enable the City to judge his/her responsibility, experience, skill, and business and financial standing. Detail any involvement, past or current, relative to litigation or other disputes, if any, concerning Bidder's performance. Insert detail in space provide below:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slightly textured appearance and is set against a dark background.

Signature of Bidder

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS
BIDDER'S STATEMENT OF PAST CONTRACT DISQUALIFICATIONS
for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

The Bidder is required to state any and all instances of being disqualified, removed, or otherwise prevented from bidding on or completing any contract for construction.

Have you ever been disqualified from any contract? ☐ Yes ☐ No

If yes, explain the circumstances in the space provided below:

Date

Signature of Bidder

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

**NON-COLLUSION AFFIDAVIT
To Be Executed by Bidder and Submitted with Bid
for**

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

State of California)
County of Riverside) ss
City of Temecula)

_____, being first duly sworn, deposes and says that he or she is _____ of _____ the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that 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 bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her 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 corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Date: _____

Signature

Print Name

Print Title

Attach Notarial Acknowledgement or Jurat for the above Signature

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BIDDER'S AGREEMENT

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM

PROJECT NO. PW19-13

The undersigned also agrees as follows:

FIRST: Provide two notarized copies of the contract with original signatures at least twenty-one days prior to the proposed contract award date; and within ten working days after the date of the Notice of Award, to furnish to the City of Temecula, two satisfactory bonds in the amounts specified in the Notice Inviting Bids guaranteeing the faithful performance of the work and payment of bills.

SECOND: To begin work within ten calendar days after the date specified in the Notice to Proceed.

Accompanying this proposal is cash, a cashier's check, or a certified check of a bidder's bond for not less than ten percent of the total amount of the bid payable to the City which is to be forfeited, as liquidated damages, if, in the event the Contractor does not execute the Contract and furnish satisfactory bonds under the conditions and within the time specified in this proposal, otherwise said cash, cashier's check, certified check, or bidder's bond is to be returned to the undersigned. Within 30 calendar days after award of the Contract, the City will return the Bidder's Bond accompanying such proposal not considered in making the award. All other bidder's bonds will be held until the Contract has been finally executed. They will then be returned to the respective bidders whose proposal they accompany.

NAME OF BIDDER

ADDRESS OF BIDDER

IMPORTANT NOTICE: If bidder is a corporation, state legal name of corporation and names of the president, secretary, treasurer, and manager; if co-partnership, state true name of firm and names of all individual co-partners composing firm; or, if individual, state first and last names in full.

Contractor is licensed in accordance with an act providing for the registration of Contractors:

LICENSE NO.

Officer's Signature

Title

Date

Officer's Signature

Title

Date

Officer's Signature

Title

Date

Signature and title of the officer(s) set forth above shall be authorized to sign contracts on behalf of the corporation, co-partnership, or individual. If signature is by an agent, other than an officer of the corporation or a member of a partnership, a Power of Attorney must be on file with the City prior to or at time of bid opening; otherwise, the bid will be subject to rejection by City Council.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

BID BOND

BOND NO. _____
(10% of the Proposal Amount)

for

FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

KNOW ALL PERSONS BY THESE PRESENT that we

NAME AND ADDRESS OF CONTRACTOR

as "Principal/Bidder," and

NAME AND ADDRESS OF SURETY

as "Surety," are held and firmly bound unto City of Temecula as "City" in the penal sum of _____ **Dollars and _____ Cents** (\$ _____), for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION are such that whereas the Principal/Bidder submitted to the City a certain Proposal, attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of **FIRE STATION 73 NEW APPARATUS BAY AND GYM, PROJECT NO. PW19-13**, and will furnish all required certificates of insurance and bonds as required by the Contract.

NOW THEREFORE, if said Proposal shall be rejected; or in the alternate, if said Proposal shall be accepted, and the Principal/Bidder shall execute and deliver a contract in the prescribed Form of Agreement, shall deliver certificates evidencing that the required insurance is in effect and shall execute and deliver Performance and Payment (Labor and Materials) Bonds in the forms prescribed, and shall in all other respects perform the agreement created by the acceptance of said Proposal, then this obligation shall be void; otherwise, this obligation shall remain in force and effect, it being expressly understood and agreed that the liability of the Surety for any and all default of the Principal/Bidder hereunder shall be the amount of this obligation as herein stated. In the event suit is brought upon this bond by City and judgment is recovered, Surety shall pay all costs incurred by City in said suit, including a reasonable attorney's fee to be fixed by the court in addition to the face amount hereof.

The Surety, for the value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall in no way be impaired or affected by an extension of the time within which the City may accept such a proposal; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the above bounded parties have executed this instrument under their several seals this _____ **day of** _____, **20**____, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

ATTEST:

Name of Principal/Bidder

Address

City, State, Zip Code

Signature of Principal/Bidder

Title

A Notarial Acknowledgement or Jurat must be attached for the Principal/Bidder Signature.

ATTEST:

Name of Surety

Address

City, State, Zip Code

Signature of Surety Official

Title

A Notarial Acknowledgement or Jurat must be attached for the Surety Official Signature.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

GENERAL SPECIFICATIONS

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

SCOPE OF WORK

The work to be done consists of furnishing all materials, equipment, tools, labor and incidentals as required by the Contract Documents to construct for the above-stated project.

The general items of work include **Construction work generally consists of concrete demolition, construction of a new 897 square foot gym, a new 2,217 square foot apparatus bay & shop/storage building; the buildings include all accessibility improvements, construction materials, finishes, plumbing, mechanical, electrical, and related work. Exterior improvements include a concrete parking lot, storm drainpipe, lighting, new trash enclosure, and landscape & irrigation. Prior to any construction, the soils will need to be improved with stone columns (or approved equal) per recommendations based on the soils report.**

Project Address: 27415 Enterprise Cir W, Temecula, CA 92590

The Engineer's estimate for the proposed project is \$4,035,000.

The lowest responsible bid shall be determined by the lowest base bid. The City may elect to award any, none, or all of an additive bid(s) at its discretion.

Bidder's self-performance requirement is a minimum of 50% of the total bid.

TIME OF COMPLETION

The Contractor shall complete all work in every detail within the time limits specified in the Contract.

UTILITY REQUIREMENTS

The Contractor is advised of the existence of the utility notification service provided by **Underground Service Alert (USA)**. USA member utilities will provide the Contractor with the precise locations of their substructures in the construction area when the Contractor gives at least two working days' notice to the Underground Service Alert by calling **(800) 422-4133**.

Contractor shall contact the appropriate regional notification center in accordance with Government Code Section 4216.2.

The Contractor shall notify the following agencies at least two working days in advance of excavating around any of their structures. The utility companies listed below can be contacted as indicated.

AT&T Pam Choy, Area Manager pc2914@att.com (626) 695-9214	AT&T OSP Engineering 22311 Brookhurst St, Ste #203 Huntington Beach, CA 92646 Attn: Joe Forkert (714) 963-7964 joef@forkertengineering.com
Charter Communications 8949 Ware Court San Diego, CA 92082 Attn: Mark Frisbie (951) 520-5482 mark.frisbie@charter.com Attn: Peter Barnes (760) 535-0076 peter.barnes@charter.com	Eastern Municipal Water District 2270 Trumble Road P.O. Box 8300 Perris, CA 92572-8300 Attn: Maroun El-Hage el-hagen@emwd.org Attn: Sambo Lay lays@emwd.org Attn: Roxanne Rountree (951) 928-3777 x 4391 rountrr@emwd.org
Frontier Communications (f/k/a Verizon) Attn: Jeff Melton jeffrey.a.melton@ftr.com (951) 434-9963 32477 Haun Rd Menifee, CA 92584	Level 3 Network Relocations (Lumen) Attn: Map Requests/Conflict Review/ General relocations@lumen.com
Metropolitan Water District of So. California 700 N. Alameda St. (Los Angeles 90012-2944) P.O. Box 54153 Los Angeles, CA 90054-0153 Attn: Shohreh Zareh (213) 217-6534 szareh@mwdh2o.com	Metropolitan Water – Skinner P.O. Box 54153 Terminal Annex Los Angeles, CA 90054 Attn: Francisco Flores (213) 217-6679
Rancho California Water District 42135 Winchester Road Temecula, CA 92590 Attn: Gregory Gill gillg@ranchowater.com (951) 296-6987 – Direct Line (951) 296-6900 – Main Line	Southern California Edison Company 24487 Prielipp Road Wildomar, CA 92595 Attn: Melissa Martin (626) 862-9996 Email: melissa.martin@sce.com
Southern California Gas Company 1981 W. Lugonia Avenue Redlands, CA 92373 Attn: Will Liao	SoCalGas 25620 Jefferson Ave. Murrieta, CA 92562 Attn: Adam Eventov

(840) 213-5899 wliao@socalgas.com Attn: Josh Rubal (213) 231-7978 jrubal@socalgas.com Attn: Carlos Portillo (213)231-8130 cportillo@socalgas.com	(951) 303-5140 aeventov@socalgas.com
Underground Service Alert (USA) 1-800-422-4133	Western Municipal Water Development Services staff 951-571-7133 Development Services Supervisor 951-571-7276 14205 Meridian Parkway Riverside, CA 92518 Direct line to Operations Center 951.789.5100, 24HR Emergency line is 951.789.5109. Water Distribution Larry Chanes, Operations Manager Direct: 951.789.5143 Email: lchanes@wmwd.com Sanitary Sewer Alex Chang, Operation Manager Direct: 951.789.5117 Email: achang@wmwd.com

The California Public Utilities Commission mandates that, in the interest of public safety, mainline gas valves be maintained in a manner to be readily accessible and in good operating condition. The Contractor shall notify the Southern California Gas Company's Headquarters Planning Office at (714) 634-3258 at least two working days prior to the start of construction.

UTILITY LOCATION

City acknowledges its responsibilities with respect to locating utility facilities pursuant to California Government Code Section 4215.

FLOW AND ACCEPTANCE OF WATER

It is anticipated that storm, surface, or other waters will be encountered at various times during the work herein contemplated. The Contractor, by submitting a bid, acknowledges that it has investigated the risk arising from such waters and has prepared its bid accordingly; and Contractor submitting a bid assumes all said risk.

The Contractor shall conduct its operations in such a manner that storm or other existing waters may proceed uninterrupted along their existing street or drainage courses. Diversions of water for

short reaches to protect construction in progress will be permitted if public and/or private properties, in the opinion of the Engineer, are not subject to probability of damage. The Contractor shall obtain written permission from the applicable public agency or property owner before any diversion of water outside of public right-of-way will be permitted.

REMOVAL OF WATER

The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and properly dispose of all water entering the excavations or other parts of the work. No concrete footing or floor shall be laid in water, nor shall water be allowed to rise over them until the concrete or mortar has set. De-watering for the structures and pipelines shall commence when ground water is first encountered and shall be continuous until such time as water can be allowed to rise in accordance with the above paragraph. De-watering shall be accomplished by well points or some other method which will insure a dry hole and preservation of final lines and grade of the bottoms of excavation, all subject to the approval of the Engineer.

Disposal of water from de-watering operations shall be the sole responsibility of the Contractor. Disposal methods shall conform to the Porter-Cologne Water Quality Control Act of 1974, the Federal Water Pollution Control Act Amendments of 1972, and the California Administrative Code, Title 23, Chapter 3.

Full compensation of de-watering shall be considered as included in the contract prices paid for the related items of work, and no additional compensation will be allowed therefor.

TRENCH SAFETY AND SHORING EXCAVATION

In accordance with Section 6500 of the Labor Code, the Contractor is required to obtain a permit from the Division of Industrial Safety for any trench or excavation which is five feet or more in depth and into which a person is required to descend.

The Contractor shall furnish all labor, equipment, and materials required to design, construct, and remove all sheeting, shoring, and bracing or other equivalent method of support of this project.

Excavation for any trench five feet or more in depth shall not begin until the Contractor has received approval from the City Engineer of the Contractor's detailed plan for worker protection from hazards of caving ground. Such plan shall be submitted at least five days before the Contractor intends to begin excavation and shall show the details of the design of shoring, bracing, sloping, or other provisions to be made for worker protection during excavation. No such plan shall allow the use of shoring, sloping, or a protective system less effective than required by Construction Safety Orders of the Division of Industrial Safety; and if such plan varies from the shoring system standards established by the Construction Safety Orders, the plan shall be prepared and signed by the Engineer who is registered as a Civil or Structural Engineer in the State of California.

Prior to the beginning of excavations requiring shoring, the Contractor shall designate in writing to the Engineer someone whose responsibility it is to supervise the project safety measures and someone whose responsibility it is to supervise the installation and removal of sheeting, shoring and bracing.

In addition to shoring the excavations in accordance with the minimum requirements of Industrial Safety Orders, it shall be the Contractor's responsibility to provide any and all additional shoring required to support the sides of the excavation against the effects of load which may exceed those desired by using the criteria set forth in the Industrial Safety Orders. The Contractor shall be solely responsible for any damages which may result from its failure to provide adequate shoring of the excavation under any and all of the conditions of loading which may exist or which may arise during construction of the project.

The Contractor shall include in its bid all costs for the above requirements. Full compensation for sheeting, shoring, bracing, and all other things necessary shall be considered as included in the appropriate bid items of work, and no additional allowance will be made therefor.

TRENCH PROTECTION AND EXCAVATION

Contractor shall submit its detailed plan for worker protection during the excavation of trenches required by the scope of the work in accordance with Labor Code Section 6705.

- a. Contractor shall, without disturbing the condition, notify City in writing as soon as Contractor, or any of Contractor's subcontractors, agents, or employees have knowledge and reporting is possible, of the discovery of any of the following conditions:
 - i) The presence of any material that the Contractor believes is hazardous waste, as defined in Section 25117 of the Health and Safety Code;
 - ii) Subsurface or latent physical conditions at the site differing from those indicated in the specifications; or
 - iii) Unknown physical conditions at the site of any unusual nature, different materially for those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract.
- b. Pending a determination by the City of appropriate action to be taken, Contractor shall provide security measure (e.g., fences) adequate to prevent the hazardous waste or physical conditions causing bodily injury to any person.
- c. City shall promptly investigate the reported conditions. If City, though, and in the exercise of its sole discretion, determines that the conditions do materially differ, or do involve hazardous waste, and will cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, then City shall issue a Change Order.
- d. In the event of a dispute between City and Contractor as to whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, Contractor shall not be excused from any scheduled completion date, and shall proceed with all work to be performed under the contract. Contractor shall retain any and all rights which pertain to the resolution of disputes and protests between the parties.

STANDARD SPECIFICATION

The Standard Specifications of the City are contained in the most recent edition of the "Standard Specifications for Public Works Construction," including all supplements as written and promulgated by Public Works Standards, Inc. Copies of those Standard Specifications are available from the publisher:

BNi Building News
Division of BNi Publications, Inc.
990 Park Center Drive, Suite E
Vista, CA 92081
(760) 734-1113

The Standard Specifications set forth above will control the general provisions, construction material, and construction methods for this contract except as amended by the Plans, Special Provisions, or other Contract Documents.

The Section numbers of the following Special Provisions coincide with those of the "Standard Specifications for Public Works Construction." Only those sections requiring amendment or elaboration, or specifying options, are called out.

In case of conflict between the Standard Specifications and the Special Provisions, The Special Provisions shall take precedence over and be used in lieu of such conflicting portions.

Where applicable, all grading, erosion and sediment control shall conform to the City of Temecula's "Temecula Municipal Code Chapter 1.8.18, Erosion and Sediment Control."

References in the Special Provisions to "Caltrans Standard Specifications" or "State Standard Specifications" shall mean the State of California, Standard Specifications, (latest edition), issued by the California Department of Transportation. Copies of these specifications may be obtained from:

State of California – Department of Transportation
Central Publication Distribution Unit
6002 Folsom Boulevard
Sacramento, California 95819

Where the Plans or Specifications describe portions of the work in general terms, but not in complete detail, it is understood that the item is to be furnished and installed complete and in place and that only the best general practice is to be used. Unless otherwise specified, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract.

WAGE RATES AND LABOR CODE REQUIREMENTS

Wage Rates

The Contractor and all Subcontractors (including without limitation, an entity subject to the provisions of Labor Code Section 1720.9) shall be required to adhere to the general prevailing rate of per diem wages as determined and published by the State Director of the Department of Industrial Relations, pursuant to Section 1770, 1773, and 1773.2 of the California Labor Code. Copies of these rates and the latest revisions thereto are on file in the Office of the Secretary of the Board of Directors and are available for review upon request.

Attention is directed to the provisions of Sections 1774, 1775, 1776, 1777.5, and 1777.6 of the State Labor Code. Sections 1774 and 1775 require the Contractor and all Subcontractors to pay not less than the prevailing wage rates to all workmen employed in the execution of the Contract and specify forfeitures and penalties for failure to do so. The minimum wages to be paid are those determined by the State Director of the Department of Industrial Relations. Section 1776 requires the Contractor and all Subcontractors to keep accurate payroll records, procedures and certain notices required of the Contractor pertaining to their location.

Apprentices

Section 1777.5 requires the Contractor or Subcontractor employing tradesmen in any apprenticeable occupation to apply to the Joint Apprenticeship Committee nearest the site of the Public Works project, which administers the apprenticeship program in that trade for a certificate of approval. The certificate will also fix the ratio of apprentices to journeymen to be used in the performance of the Contract.

The Contractor is required to make contributions to funds established for the administration of apprenticeship programs if it employs registered apprentices or journeymen in any apprenticeable trade and if other Contractors on the public works site are making such contributions.

Information relative to apprenticeship standards, contributions, wage schedules, and other requirements may be obtained from the State Director of Industrial Relations or from the Division of Apprenticeship Standards.

SUBSTITUTION OF SECURITIES

In conformance with Section 22300 of the Public Contract Code, the Contractor may substitute securities for any monies withheld by the City to ensure performance under the Contract.

At the request and expense of the Contractor, securities equivalent to the amount withheld shall be deposited with the City or with a State or Federally chartered bank as the escrow agent who shall pay such monies to the Contractor upon notification by City of Contractor's satisfactory completion of the Contract.

The type of securities deposited and the method of release shall be approved by the City Attorney's office.

SUBCONTRACTING

In the event a Subcontractor requests a hearing on being substituted out of the work covered by this Contract pursuant to Public Contract Code Section 4107(a), City hereby designates the following as its hearing officer:

JAMS AND DISPUTE, formerly JAMS
500 N. State College Bldg., Suite 600
Orange, CA 92668
(714) 939-1300

Contractor and the requesting Subcontractor shall be responsible for splitting equally the costs of such hearing by making an advance deposit with JAMS AND DISPUTE as a precondition to subcontract bid submittal.

DISPOSAL OF MATERIALS

The City of Temecula has an exclusive franchise agreement for solid waste and recycling hauling services with CR&R Incorporated ("Franchisee"). **The Contractor shall be responsible for making arrangements with the Franchisee for recycling and solid waste removal, including construction and demolition debris (C&D).**

Prior to bidding this project, the Contractor, at his discretion, may contact the Franchisee to inquire about their service availability and the cost for construction and demolition waste hauling and disposal at an approved CR&R recycling center. The Contractor may inform the Franchisee that this is a City of Temecula project and provide them with the following project information:

FIRE STATION 73 NEW APPARATUS BAY AND GYM PROJECT NO. PW19-13

Contact information for the Franchisee and the representative is as follows:

CR&R Incorporated
Attn: Ed Campos
P.O. Box 1208

Perris, CA 92572
(951) 657-7503

The Contractor may elect to use the services of another recycling vendor provided that the vendor has a valid City of Temecula Recycling Permit, and the recyclable materials are either donated or sold to the vendor. Under no circumstances may a vendor, other than the Franchisee, charge the Contractor for recycling bin rental, recycling services, consultation, or any other service related to recycling.

The following are exclusions and limitations of Franchisee's ability to handle specific materials:

- **Export of Excess and Unsuitable Dirt.** Franchisee will not haul excess dirt.
- **Disposal of Hazardous Material.** Contractor shall contact the Franchisee regarding any hazardous material to determine appropriate disposal method.
- **Hauling Excessive Amounts of Coldplaned (milled) Asphalt.** Contractor shall contact the Franchisee to determine if the quantity in question can be accommodated.

Contractor shall supply proof of disposal at a recycling center, including verification of tonnage by certified weighmaster tickets, for materials that cannot be accommodated by the Franchisee or taken by any "City permitted" recycling vendor.

Contractor shall comply with applicable construction and demolition debris recycling requirements, waste management requirements, and City franchise hauling requirements.

DISTRIBUTION OF PLANS AND SPECIFICATIONS

The City can provide hardcopies of the Plans and Specifications at the expense of the Contractor.

CLAIM DISPUTE RESOLUTION

In the event of any dispute or controversy with the City over any matter whatsoever, the Contractor shall not cause any delay or cessation in or of work, but shall proceed with the performance of the work in dispute. The Contractor shall retain any and all rights provided that pertain to the resolution of disputes and protests between the parties. The disputed work will be categorized as an "unresolved dispute" and payment, if any, shall be as later determined by mutual agreement or a court of law. The Contractor shall keep accurate, detailed records of all disputed work, claims and other disputed matters.

All claims arising out of or related to the Contract or this project, and the consideration and payment of such claims, are subject to the Government Claims Act (Government Code Section 810 et seq.) with regard to filing claims. All such claims are also subject to Public Contract Code Section 9204 and Public Contract Code Section 20104 et seq. (Article 1.5), where applicable. This Contract hereby incorporates those provisions as though fully set forth herein. Thus, the Contractor or any Subcontractor must present a claim in accordance with the Government Claims Act as a prerequisite to prosecuting any claim against the City. The filing or prosecution of a construction claim in compliance with Section 9204 and/or Article 1.5 (if applicable), and must then adhere to Article 1.5 and/or Section 9204, as applicable, pursuant to the definition of "claim" as individually defined therein does not in any way obviate the need to timely present a claim under the Government Claims Act, or in any toll the expiration of any limitations period for the timely presentation of a claim under the Government Claims Act.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

SPECIAL PROVISIONS

FOR

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

The following sections of the Standard Specifications are hereby amended to read as follows:

SECTION 1 – GENERAL, TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS.

1-2 TERMS AND DEFINITIONS.

[Add the following]:

Caltrans	-	California Department of Transportation
City	-	City of Temecula
County	-	County of Riverside
Engineer	-	Director of Public Works or Authorized Representative
Federal	-	United States of America
Standard Specification, (Greenbook)	-	Standard Specifications for Public Works Construction (2024 edition), including supplements
Caltrans Standard Specifications, State Standard Specifications	-	State of California - Standard Specifications (latest edition), issued by: California Department of Transportation
Caltrans Standard Plan(s), State Standard Plan(s)	-	State of California - Standard Plans (latest edition) issued by: California Department of Transportation
E.M.W.D.	-	Eastern Municipal Water District
M.W.D.	-	Metropolitan Water District of Southern California
R.C.W.D.	-	Rancho California Water District
R.C.F.C.W.C.D.	-	Riverside County Flood Control and Water Conservation District

1-7 AWARD AND EXECUTION OF THE CONTRACT.

[Replace with the following]:

At least twenty-one calendar days prior to the proposed contract award date, the Contractor shall execute and return the following Contract Documents to the City:

- ☐ Contract (2 copies, both notarized with original signatures)

Within ten working days after the date of the Notice of Award, the Contractor shall execute and return the following Contract Documents to the City:

- ☐ Performance Bond
- ☐ Labor and Materials Bond
- ☐ Public Liability and Property Damage Insurance Certificates and Endorsements
- ☐ Worker's Compensation Insurance Certificate
- ☐ Vendors Statements

Failure to comply with the above will result in annulment of the award and forfeiture of the Proposal Guarantee.

The Contract shall not be considered binding upon the City until executed by the authorized City officials.

A corporation to which an award is made may be required, before the Contract Agreement is executed by the City, to furnish evidence of its corporate existence, of its right to enter into contracts in the State of California, and that the officers signing the Contract and Bonds for the corporation have the authority to do so.

1-7.3 Virtual Project Manager (VPM).

[Add the Following Section]:

The Contractor shall submit all required documents through the Virtual Project Manager web site at www.virtual-pm.com managed by the City. This website, "Virtual Project Manager (VPM)" will be used exclusively by the Contractor to submit and receive responses for RFI's, transmittals, submittals, additions/deletions, request for change orders, and all other project related documents and formal communications for review by the Engineer/Inspector/Construction Manager. Use of VPM requires a digital camera, computer, and internet access provided by the contractor. Submittal of hard copies of the above items can be in addition to, but not in lieu of, uploading said items to VPM. The date and time logged in by VPM for all items above shall be deemed the official time and/or date they were received.

An account logon to access VPM will be provided to the contractor by the City at no cost to the Contractor. The contractor may also request one VPM training session prior to the pre-construction meeting. One training session shall be provided by the City, at City offices, free of charge for persons involved with the project. Any additional training sessions requested, or training sessions resulting from the Contractor failing to appear at a scheduled training session, shall be at the Contractor's cost. Failure to attend and/or schedule training or use the VPM system shall not be cause for delay. All costs including but not limited to time, attending training, computer equipment, computer software, internet access, digital cameras, etc necessary for the Contractor to use VPM shall be considered incidental to the work and no separate payment shall be made therefore.

SECTION 2 – SCOPE OF THE WORK.

2-2 PERMITS.

[Replace the first sentence with the following]:

Prior to the start of any work, the Contractor shall take out the applicable City permits and make arrangements for City inspections. The Contractor and all subcontractors shall each obtain any and all permits, licenses, inspections, certificates, or authorizations required by any governing body or public utility.

Contractor shall acquire **Building & Safety Permit (B24-5413)** prior to construction at no additional cost.

2-8 EXTRA WORK.

[Add with the following]:

The following percentages shall be added to the Contractor's costs and shall constitute the markup for all overhead (including but not limited to all claims of extended home office overhead, general conditions, and jobsite supervision) and profits: (1) Labor-20%; (2) Material-15%; (3) Equipment Rental-15%; (4) Other items and Expenditures-15%.

To the sum of the costs and markups provided for in this subsection, compensation for bonding shall be at the rate specified by the bonding company.

For work done by subcontractors a markup of ten percent on the first \$5,000 of the subcontracted portion of the extra work and a markup of five percent on work added in excess of \$5,000 of the subcontracted portion of the extra work may be added by the Contractor.

SECTION 3 – CONTROL OF THE WORK.

3-5 INSPECTION.

[Add the following]:

The City of Temecula and/or its Agents to perform landscape and irrigation inspections of its projects. The City representative must be present and must sign off on the completed work. To request the presence of the landscape and irrigation inspector, the Contractor shall provide a minimum 48-hours' advanced notice to the project's Public Works Inspector before beginning crack seal, grind, patch, slurry seal, pavement marking removal, striping, or any other major work activity. The Contractor will be required to present "As-Built" irrigation drawings to the Inspector prior to any test or site observation. Failure to present these "As-Built", or provide any other item listed in this section, will result in the immediate cancellation of the test or site observation. In the event that a scheduled test or a site inspection is cancelled due to the site not being ready or the required information/material is not present on site, the Contractor will be responsible for all costs associated with the additional landscape inspector site visit(s).

Contractor shall coordinate inspections required by the City Building Official, Fire Department, Geotechnical Engineer, Engineer of Record, Architect of Record, and City Public Works Inspector. No work requiring inspection shall be covered or concealed prior to inspection and approval.

3-7 CONTRACT DOCUMENTS.

3-7.1 General.

[Replace the first paragraph with the following]:

The Contractor shall maintain a control set of Plans and Specifications on the project site at all times. All final locations determined in the field, and any deviations from the Plans and

Specifications shall be marked in red on this control set to show the as-built conditions. Upon completion of all work, the Contractor shall return the control set to the Engineer. Final payment will not be made until this requirement is met.

Adjustments to the layout of this plan may be necessary due to the unknown existing conditions. It is the Contractor's responsibility to retain the design intent. If a layout discrepancy should occur, the Contractor is to contact the City's representative.

3-8 SUBMITTALS.

3-8.1 General.

[Add the Following]:

Prior to the start of work the Contractor shall prepare in Microsoft Excel and deliver to the Engineer a log of submittals that indicates all required submittals, and for each:

- a) Estimated delivery date of the submittal.
- b) Last day submittal can be delivered to keep the project schedule (factor in response time and resubmittal/response time).

Unless otherwise stated in the Contract Documents, the Contractor shall deliver via Virtual Project Manager (VPM) all submittals in PDF format to the Project Manager at: www.virtual-pm.com. Such submittals shall be returned via VPM in PDF format. Some submittals may require material samples or hard copy of the submittal packages at the discretion of the Engineer. In such cases the hard copy and/or material samples shall be delivered to City Hall or the Project site as directed by the Engineer, this is in addition to and not in lieu of, uploading the documents to VPM including pictures of the materials samples delivered.

Contractor shall identify long-lead materials and equipment within the initial submittal schedule, including but not limited to structural steel, roofing, HVAC equipment, electrical gear, fire alarm/fire suppression components, doors/hardware, glazing, and specialty equipment.

3-10 SURVEYING.

3-10.1 General.

[Replace with the following]:

The Contractor shall take all necessary measures to ensure the preservation of survey monuments, ties and benchmarks. The Contractor shall not disturb permanent survey monuments, ties or benchmarks without the consent of the Engineer. The Contractor shall protect all survey monuments, ties, benchmarks, and monument covers. The Contractor shall notify the Engineer prior to covering, disturbing, adjusting, or removing any monumentation. The Contractor will bear the expense for replacing any monumentation that may be disturbed without permission.

When a change is made in the finished elevation of the pavement of any roadway in which a permanent survey monument is located, the Contractor shall adjust the monument cover to the new grade or remove and replace the monument and/or ties per the City of Temecula Standard No.'s 700, 700A, and 701, unless otherwise specified. All new monuments and ties shall conform to the Professional Land Surveyors' Act of the Business and Professions Code, Section 8700 et seq. When a monument or tie is to be re-set, the Contractor will be required to record a map, field notes, and/or other pertinent records, with the County of Riverside and shall submit a copy to the City Permit Engineer.

Surveying and/or construction staking for the entire project shall be the responsibility of the Contractor and performed by a registered Civil Engineer or Land Surveyor at the Contractor's

expense. The Contractor shall submit a copy of all survey notes and a Certificate of line and grade to the City and the engineer of record.

All existing monumentation, which may be destroyed or covered by the proposed work, shall be referenced prior to construction; and Corner Records shall be filed, pre and post construction, in accordance with Section 8771 of the Business and Professions Code (AB 1414). Final monumentation of alignments and new right-of-way lines shall be performed in accordance with the State of California Surveys Manual (latest edition); Records of Survey, or In- Lieu Maps, as applicable, shall be prepared and filed. One reproducible copy of all filed maps, and one photocopy of all filed Corner Records, shall be delivered to the City Permit Engineer within ten days of such fillings.

3-12 WORK SITE MAINTENANCE.

3-12.3 Noise Control.

[Add the following]:

A noise level limit of 86 dBA at a distance of 50 feet shall apply to all construction equipment on or related to the job whether owned by the Contractor or not. The use of excessively loud warning signals shall be avoided except in those cases required for the protection of personnel.

3-12.4 Storage of Equipment and Materials.

3-12.4.1 General

[Add the following]:

The contractor shall maintain at a minimum, 5 parking stalls inside the work area for the fire crew's use. The crew shall have 24-hour access to the parking stalls. The existing parking shall not be used for storage nor shall any work impede the crew's operations.

[Add the following section]:

3-12.7 Graffiti Control.

The contractor shall remove graffiti from all work, materials, equipment, and signs within the project. Equipment, materials, or signs containing graffiti shall not be brought to the project. Any graffiti found on work, materials, equipment or signs shall be cleaned or removed from the project within 24 hours from discovery. The cost of graffiti removal shall be borne by the Contractor, and shall be considered as being included in the various Contract items.

3-13 COMPLETION, ACCEPTANCE, AND WARRANTY.

3-13.2 Acceptance.

[Replace with the following paragraph]:

If, in the Engineer's judgment, the Work has been completed and is ready for acceptance, he/she will so certify to the City, which may accept the completed work. The date the City accepts the Work as completed will be the date the Contractor is relieved from responsibility to protect the Work.

3-13.3 Warranty.

[Replace with the following paragraph]:

All work shall be warranted by the Contractor against defective workmanship and material for a period of one year. The warranty period shall start on the date the City Council approves the Notice of Completion for the work. The Contractor shall replace or repair any such defective work in a manner satisfactory to the Engineer, after notice to do so from the Engineer, and within the time specified in the notice. If the Contractor fails to make such replacement within the time specified

in the notice, the City may perform this work and the Contractor's sureties shall be liable for the cost thereof.

SECTION 4 – CONTROL OF MATERIALS.

4-4 TESTING.

[Replace the first paragraph with the following]:

Before incorporation in the Work, the Contractor shall submit samples of materials, as the Engineer may require, at no cost to the City. The Contractor, at its expense, shall deliver the materials for testing to the place and at the time designated by the Engineer. The City shall bear the cost of all initial testing. The cost of any retesting necessary to verify material quality or workmanship performed subsequent to initial testing shall be the Contractor's responsibility. All costs associated with any retesting shall be deducted from any amounts due the Contractor.

The Contractor shall coordinate with the City's designated testing laboratory, special inspector, geotechnical engineer, and Building Official for required testing and inspections. Failed tests, retesting, and corrective work shall be at Contractor's expense.

SECTION 5 – LEGAL RELATIONS AND RESPONSIBILITIES.

5-1 LAWS AND REGULATIONS.

[Add the following]

Attention is directed to the Surface Mining and Reclamation Act of 1975 (SMARA), commencing in Public Resources Code, Mining and Geology, Section 2710, which establishes regulations pertinent to surface mining operations. Senate Bill 649, Kuehl, Chapter 794 of the Statutes 2003, effective January 1, 2004, prohibits surface mining operations which are subject to SMARA from selling California mined construction material to a local agency unless the operation is identified in a list referred to as the 3098 List.

Material from mining operations furnished for this project shall only come from permitted sites in compliance with the SMARA.

5-3 LABOR.

5-3.1 General.

[Add the following]:

The Contractor, and all subcontractors, suppliers, and vendors shall comply with applicable Agency, State, and Federal orders regarding affirmative action to ensure equal employment opportunities and fair employment practices. Failure to file any report due under said orders will result in suspension of periodic progress payments.

The Contractor shall ensure unlimited access to the job site for all equal employment opportunity compliance officers.

5-3.3 Payroll Records.

[Add the following]:

Payroll records, shall be submitted to the City by the tenth day of each month. Progress payments will be withheld pending receipt of any outstanding reports.

5-4 INSURANCE.

[Replace section with the following]:

Contractor shall procure and maintain for the duration of the contract insurance against claims for injuries to persons and/or damages to property, which may arise from or in connection with the performance of the work hereunder and the results of work by the Contractor, its agents, representatives, employees, or subcontractors.

a. Minimum Scope of Insurance. Coverage shall be at least as broad as:

1) Commercial General Liability (CGL): Insurance Services Office Form CG 00 01 covering CGL on an "occurrence" basis, including products and completed operation, property damage, bodily injury, and personal & advertising with limits no less than Two Million (\$2,000,000) per occurrence. If a general aggregate limit applies, either the general aggregate limit shall apply separately to this project/location (ISO CG 25 03 05 09 or 25 04 05 09) or the general aggregate limit shall be twice the required occurrence limit.

2) Automobile Liability: ISO Form Number CA 00 01 covering any auto (Code 1), or if Contractor has no owned autos, covering hired, (Code8) and non-owned autos (Code 9), with limits no less than One Million (\$1,000,000) per accident for bodily injury, including death, of one or more persons, property damage and personal injury.

3) Workers' Compensation: as required by the State of California, with Statutory Limits, and Employer's Liability Insurance with limit of no less than One million (\$1,000,000) per accident for bodily injury or disease. In accordance with the provisions of Labor Code Section 3700, every contractor will be required to secure the payment of compensation to it's employees. Pursuant to Labor Code Section 1861, Vendor must submit to City the following certification before beginning any work on the Improvements:

I am aware of the provisions of Section 3700 of the Labor Code which 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 the work of this contract.

By executing this Agreement, Vendor is submitting the certification required above.

The policy must contain a waiver of subrogation in favor of the City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

b. Deductibles and Self-Insured Retentions. Any deductibles or self-insured retentions must be declared and approved by the Risk Manager.

c. Other Insurance Provisions. The insurance policies are to contain, or be endorsed to contain, the following provisions:

1) The City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees and volunteers are to be covered as additional insureds on the CGL policy with respect to liability arising out of work or operations performed by or on behalf of the Contractor's products and completed operations of the Contractor; premises owned, occupied or used by the Vendor. General liability coverage can be provided in the form of an endorsement to the Contractor Insurance (at least as broad as ISO Form CG 20 10 11 85 or if not available, through the addition of both CG 20 10, CG 20 26, CG 20 33, or CG 20 38; and CG 20 37 if a later edition is used). The coverage shall contain no special limitations on the scope of protection afforded to the City of Temecula, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

2) For any claims related to this project, the Contractor insurance coverage shall be primary and non-contributory and at least as broad as ISO CG 20 01 04 13 as respects the City, the Temecula Community Services District, the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the City of Temecula, Temecula Community Services District, and/or the Successor Agency to the Temecula Redevelopment Agency, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it. This also applies to any Excess or Umbrella liability policies.

3) The Contractor may use Umbrella or Excess Policies to provide the limits as required in this agreement. The Umbrella or Excess policies shall be provided on a true "following form" or broader coverage basis, with coverage at least as broad as provided on the underlying Commercial General Liability Insurance.

4) Any failure to comply with reporting or other provisions of the policies including breaches of warranties shall not affect the indemnification provided to the City of Temecula, the Temecula Community Services District, and/or the Successor Agency to the Temecula Redevelopment Agency, their officers, officials, employees, or volunteers.

5) The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

6) If the Contractor's maintains broader coverage and/or higher limits than the minimums shown above, the City requires and shall be entitled to the broader coverage and/or higher limits maintained by the contractor.

7) If insurance coverage is canceled or, reduced in coverage or in limits the Contractor shall within two (2) business days of notice from insurer phone, fax, and/or notify the City via certified mail, return receipt requested of the changes to or cancellation of the policy.

8) Unless otherwise approved by City, if any part of the Services and Tasks is subcontracted, the Minimum Insurance Requirements must be provided by, or on behalf of, all subcontractors even if city has approved lesser insurance requirements for Contractor, and all subcontractors must agree in writing to be bound by the provisions of this section.

d. Acceptability of Insurers. Insurance required above, except for workers' compensation insurance, must be placed with insurers with a current A.M. Best rating of A-: VII or better, unless otherwise acceptable to the City. Self-insurance shall not be considered to comply with these insurance requirements.

e. Verification of Coverage. Contractor shall furnish the City with original certificates and amendatory endorsements, or copies of the applicable policy language affecting coverage required by this clause. All certificates and endorsements and copies of the Declarations & Endorsements pages are to be received and approved by the City before work commences. However, failure to obtain the required documents prior to the work beginning shall not waive the Contractor obligation to provide them. The City reserves the right to require complete, certified copies of all required insurance policies, including endorsements required by these specifications, at any time.

f. Special Risks or Circumstances. The City reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

5-7 SAFETY.

5-7.1 Work Site Safety

5-7.1.1 General.

[Add the following]:

All existing traffic control signs and street name signs shall be maintained in visible locations as directed by the Engineer.

No detours will be allowed. The Contractor will be required to conduct its operation in such a manner that traffic will be permitted to pass through the work with as little delay as possible.

All warning lights, signs, flares, barricades and other facilities for the sole convenience and direction of public traffic shall be furnished and maintained by the Contractor. All signs shall conform to and be placed in accordance with the current "Manual of Traffic Controls", issued by the California Department of Transportation for construction and maintenance of work zones. The Contractor shall utilize Solar Powered Equipment to maintain and control existing traffic. Battery operated equipment shall be utilized for night time operations.

All construction signs shall be either covered or removed when not required by the nature of the work, or if no present hazard to the motorists exists.

Payment for implementing traffic controls as required by these Special Provisions shall be made at the contract lump sum price paid for traffic control systems and shall include full compensation for all labor, materials, and equipment necessary to install and maintain traffic controls throughout the construction period.

5-7.2 Safety Orders.

[Add the following]:

The Contractor shall comply with the provisions of any City ordinances or regulations regarding requirements for the protection of excavations and the nature of such protection.

SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK.

6-1 CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK.

6-1.1 Construction Schedule.

[Replace the first paragraph with the following]:

The Contractor's proposed Construction Schedule shall be submitted to the Engineer within ten working days after the date of the Notice of Award of Contract. The schedule shall be supported by written statements from each supplier of materials or equipment indicating that all orders have been placed and acknowledged and setting forth the dates that each item will be delivered. The schedule shall be in the form of a tabulation, chart, or graph.

The Contractor shall submit a baseline schedule identifying critical path activities, long-lead procurement, permit inspections, special inspections, utility coordination, fire station access constraints, commissioning, punch list, closeout, and substantial completion.

Prior to issuing the Notice to Proceed, the Engineer will schedule a pre-construction meeting with the Contractor to review the proposed Construction Schedule and delivery dates, arrange the utility coordination, discuss construction methods, and clarify inspection procedures.

The Contractor shall submit periodic Progress Reports to the Engineer by the tenth day of each month. The report shall include an updated Construction Schedule. Any deviations from the original schedule shall be explained. Progress payments will be withheld pending receipt of any outstanding reports.

Prior to final acceptance, Contractor shall provide as-builts, warranties, O&M manuals, training records, testing reports, special inspection reports, commissioning documentation, final permit approvals, and all required closeout documents.

6-3 TIME OF COMPLETION.

6-3.2 Contract Time Accounting.

[Add the following]:

The Contractor's activities shall be confined to the hours between 7:00 a.m. and 4:30 p.m. Monday through Friday, excluding holidays. Deviation from these hours will not be permitted without the prior consent of the Engineer, except in emergencies involving immediate hazard to persons or property.

In the event of either a requested or emergency deviation, inspection service fees will be charged against the Contractor. The service fees will be calculated at overtime rates, including benefits, overhead and travel time. The service fees will be deducted from any amounts due the Contractor.

6-7 TERMINATION OF THE CONTRACT FOR DEFAULT.

[Add the following for emphasis]:

If the Contractor fails to begin delivery of material and equipment, to commence the Work within the time specified, to maintain the rate of delivery of material, to execute the Work in the manner and at such locations as specified, or fails to maintain the Work schedule which will ensure the City's interest, or, if the Contractor is not carrying out the intent of the Contract, the City may serve written notice upon the Contractor and the Surety on its Performance Bond demanding satisfactory compliance with the Contract.

The Contract may be canceled by the City without liability for damage, when in the City's opinion the Contractor is not complying in good faith, has become insolvent, or has assigned or subcontracted any part of the Work without the City's consent. In the event of such cancellation, the Contractor will be paid the actual amount due based on Contract Unit Prices or lump sums bid and the quantity of the Work completed at the time of cancellation, less damages caused to the City by acts of the Contractor. The Contractor, in having tendered a Bid, shall be deemed to have waived any and all claims for damages because of cancellation of Contract for any such reason. If the City declares the Contract canceled for any of the above reasons, written notice to that effect shall be served upon the Surety. The Surety shall, within five days, assume control and perform the Work as successor to the Contractor.

If the Surety assumes any part of the Work, it shall take the Contractor's place in all respects for that part, and shall be paid by the City for all work performed by it in accordance with the Contract. If the Surety assumes the entire Contract, all money due the Contractor at the time of its default shall be payable to the Surety as the Work progresses, subject to the terms of the Contract.

If the Surety does not assume control and perform the Work within five days after receiving notice of cancellation, or fails to continue to comply, the City may exclude the Surety from the premises. The City may then take possession of all material and equipment and complete the Work by City forces, by letting the unfinished Work to another Contractor, or by a combination of such methods. In any event, the cost of completing the Work shall be charged against the Contractor and its Surety and may be deducted from any money due or becoming due from the City. If the sums due under the Contract are insufficient for completion, the Contractor or Surety shall pay to the City within five days after the completion, all costs in excess of the sums due.

The provisions of this subsection shall be in addition to all other rights and remedies available to the City under law.

6-9 LIQUIDATED DAMAGES.

[Replace with the following]:

Failure of the Contractor to complete the Work within the time allowed will result in damages being sustained by the City. Such damages are, and will continue to be, impracticable and extremely

difficult to determine. For each consecutive calendar day in excess of the time specified for completion of Work, as adjusted in accordance with 6-6, the Contractor shall pay the City, or have withheld from monies due it, the sum stated in the Contract, unless otherwise provided in the Specifications.

Execution of the Contract shall constitute agreement by the City and Contractor that the sum stated in the Contract is the minimum value of the costs and actual damage caused by the failure of the Contractor to complete the Work within the allotted time. Such sum is liquidated damages and shall not be construed as a penalty, and may be deducted from payments due the Contractor if such delay occurs.

SECTION 7 – MEASUREMENT AND PAYMENT.

7-3 PAYMENT.

[Add the following]:

7-3.9 Final Pay Quantities.

When an item of work is designated as (F) on the plans or in the bid schedule or prices, the estimated quantity for that item of work shall be the final pay quantity, unless the dimensions of any portion of that item are revised by the Engineer, or the item or any portion of the item is eliminated. If the dimensions of any portion of the item are revised, and the revisions result in an increase or decrease in the estimated quantity of that item of work, the final pay quantity for that item will be revised in the amount represented by the changes in dimensions, except as otherwise provided for minor structures in Section 51-7.01D, "Payment" of the Caltrans Specifications.

The estimated quantity for each item of work designated as (F) in the bid schedule of prices or on the plans shall be considered as approximate only, and no guarantee is made that the quantity which can be determined by the computations, based on the details and dimensions shown on the plans, will equal the estimated quantity.

In case of discrepancy between the quantity shown in the bid schedule of prices for final pay item and the quantity or summation of the quantities for the same item shown on the plans, payment will be based on the quantity showing in the bid schedule of prices.

SECTION 10 – CONSTRUCTION DETAILS.

10-01 CONSTRUCTION OF FIRE STATION 73 APPARATUS BAY AND GYM

Fire Station 73 Apparatus Bay and Gym shall be in accordance with the Plans, Specifications, Contract Documents, the provisions included in the Greenbook, Technical Specifications, and these Special Provisions as well as the Building Permit and all applicable laws codes and standards.

The Contractor's attention is directed to more specific requirements (e.g., submittals and basis of design elements) outlined within the Technical Specifications. Contractor will be responsible for any and all direct or incidental damaged caused by their work under this contract.

Prior to starting construction, the Contractor shall contact Battalion Chief in advance to let them know the Construction Schedule and when construction will begin.

Contractor shall identify, submit, and procure long-lead items immediately after Notice to Proceed and shall include anticipated procurement durations in the baseline schedule. Contractor will immediately place orders for long lead items.

The Contractor shall provide a written two-week notification to the City of Temecula and the Fire Department on when the construction will start.

The contractor shall maintain at a minimum, 5 parking stalls inside the work area for the fire crew's use. The crew shall have 24-hour access to the parking stalls. The existing parking shall not be used for storage nor shall any work impede the crew's operations.

Work shall be performed while the Fire Station remains fully operational and functional throughout construction. The Contractor shall coordinate all work activities to avoid disruption to emergency response operations.

Contractor shall not block emergency vehicle access, apparatus circulation, staff access, utility service, communication systems, or emergency response operations without prior written approval from the City and Fire Department.

Contractor shall maintain emergency vehicle access at all times. Any temporary restriction to access, parking, utilities, communication systems, or circulation shall require prior written approval from the City and Fire Department.

The Contractor shall furnish and install (1) Construction project information signs per City Standard No. 408. The City reserves the right to revise the wording of the signs prior to installation.

Schedule of Values: The Contractor shall submit, for approval by the Engineer, a schedule of values detailing the cost breakdown of the contract lump sum item for Fire Station 73 Gym. The schedule of values shall reflect the items of work, quantities and costs. The sum of amounts for the units of work listed in the schedules of values shall be equal to the contract lump sum price Fire Station 73 Gym. The schedule of values shall be used to determine progress payments for the Fire Station 73 Gym during progress of the work.

Construction Signing and Work Area Protection: Contractor shall provide adequate warning and advisory signage (i.e., off limits and detours) for their work area (e.g., lay down area, crane placement and/or material storage) and furnish and install adequate fencing, barricades and/or signage for these items within or adjacent to the existing Fire Station 73 to ensure continual passage of all vehicles (i.e., patrons, staff, etc.). Furthermore, should any vehicular access restrictions or haul routes be necessary to complete the work the Contractor shall submit a detailed work area layout and vehicular closure plan, with exact date(s) when these plans will be enacted, to the City for approval prior to implementation.

PAYMENT

The contract unit price for Fire Station 73 Apparatus Bay and Gym will be paid by lump sum. The payment for Fire Station 73 Apparatus Bay and Gym will include all work, labor, materials, equipment, permits, reports, and coordination to complete all exterior, interior, and site improvements necessary to complete the project that is not already included in other bid items. This includes but is not limited to all building and site preparation, concrete, stucco, foundations, framing, paint, carpentry, carpeting & flooring, lighting, electrical, plumbing HVAC, roofing, equipment, tile, casework, millwork, countertops, signage, fire suppression, and alarm work not specifically covered in another bid item that is necessary to complete all work shown on the plans, contract documents and all relevant codes, laws, practices, and standards. The quantity to be paid on each progress payment will be based upon the percent complete of each line item identified in the Schedule of Values.

10-02(S) REMOVE AND REPLACE LANDSCAPE.

This is a "Specialty Item" of work. Remove and Replace Landscape shall conform to scope of work identified on construction plan Sheets LP-1, LP-2 and LP-3, and these Special Provisions.

All landscape work between the limits of the new additions to the edge of existing landscape shall be completed in accordance with the Special Provisions, Temecula Public Works Department Landscape Standards Booklet, and installation details.

Contractor shall protect existing landscaping and irrigation outside the approved limits of work. Any damage caused by Contractor operations shall be repaired or replaced at Contractor's expense.

This item of work includes the 90-day plant establishment period.

PAYMENT

The contract unit price for Remove and Replace Landscape will be paid by lump sum. The payment for Remove and Replace Landscape will include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in protecting in place and/or removing and replacing existing landscaping and/or installing new landscaping, complete in place, as shown on the plans, as specified in the Greenbook, these Special Provisions, the Technical Specifications, and as directed by the Engineer, and no additional compensation shall be made. This item of work includes the 90-day plant establishment period. The quantity to be paid on each progress payment will be based upon the percent complete of each line item identified in the Schedule of Values.

10-03(S) REMOVE AND REPLACE IRRIGATION.

Remove and Replace Irrigation shall conform to scope of work identified on construction plan Sheets LI-1 through LI-5.

All irrigation work shall be completed in accordance with the Special Provisions, Temecula Public Works Department Landscape Standards Booklet, and installation details.

The contractor shall be responsible for all temporary irrigation of affected landscaping, including any adjacent turf areas, during construction.

PAYMENT

The contract unit price for Remove and Replace Irrigation will be paid by lump sum. The payment for Remove and Replace Irrigation will include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in protecting in place and/or removing and replacing existing irrigation systems or installing new irrigation systems, complete in place, as shown on the plans, as specified in the Greenbook, these Special Provisions, the Technical Specifications and as directed by the Engineer, and no additional compensation shall be made. The quantity to be paid on each progress payment will be based upon the percent complete of each line item identified in the Schedule of Values.

10-04(S) CIVIL CONSTRUCTION.

This is a "Specialty Item" of work. Civil Construction shall conform to scope of work identified on construction plan Sheets 1 through 7, and these Special Provisions.

Civil Construction shall include demolition, onsite and offsite civil work, and Traffic Control.

Traffic Control Plan requirements are provided in Exhibit B.

Offsite storm drain work and street resurfacing must be done first, prior to onsite work, including gym and apparatus bay construction. Contractor shall include this sequencing requirement in the baseline schedule.

Asphalt Concrete (AC) materials shall conform to Section 203-6, Asphalt Concrete, of the Greenbook. AC shall be Type B-PG 70-10 for the base course and Type C2 PG 70-10 for finish and overlay courses.

When asphalt pavement is to be placed directly on subgrade material, the uppermost 12" of subgrade material shall be scarified, moisture conditioned per Section 301-1.2, Preparation of Subgrade, of the Greenbook and compacted to achieve a minimum 95% relative compaction per ASTM D-1557.

Construction shall be in accordance with Section 302-5, Asphalt Concrete Pavement, of the Greenbook and these Special Provisions.

302-5.1 General.

[Add the following]:

Where AC pavement is being constructed as an overlay directed upon existing hard surfaced pavement; existing cracks or holes ¼" or larger shall be cleaned, repaired and filled with liquid asphalt, slurry, hot mix or as directed by the Engineer. Existing cracks smaller than ¼" shall be cleaned of vegetation only. Cleaning of cracks or holes shall be by power brooming, compressed air or other approved methods.

302-5.3 Prime Coat.

[Replace with the following]:

A prime coat will not be required for this project.

302-5.5 Distribution and Spreading.

[Add the following]:

All final lifts shall be 1½" thick unless otherwise approved by the Engineer. Where new asphalt pavement is being constructed adjacent to an overlay, the final lift of the new pavement and the overlay shall be placed concurrently.

AC finish course shall be placed only when the atmospheric temperature is 50 degrees F and rising. AC base course shall be placed only when the atmospheric temperature is 40 degrees F and rising.

Except during nighttime paving operations; delivery of AC by a truck that leaves the plant later than 3:30 p.m. will not be accepted for placement during that day.

The Contractor shall utilize Automatic Screed control as required by the Engineer for asphalt paving. All paving machines, rollers and Automatic Screed Control equipment including size, number and type, are subject to the approval of the Engineer.

Unless approved otherwise, ski type devices, with a minimum length of 30', shall be used to provide a reference for the grade sensor. Skis shall be constructed and installed in such a manner that a reference to the average elevation of the existing pavement, along the length of ski, is maintained at the sensor point. When placing surfacing adjacent to surfacing previously placed in conformance with these provisions, a joint matching shoe, of adequate size and type to properly sense the grade of the previously placed mat, may be used in lieu of the 30' ski. The ski shall be mounted at a location, which will provide an accurate reference for the surfacing being placed. This may require the ski to be mounted ahead of, and inside the outer limits of the screed. Automatic cross slope control may be accomplished by use of a ski and grade sensor on each side of the paving machine.

302-5.6.2 Density and Smoothness.

[Add the following]

When new pavement joins existing, the surface will be inspected at locations determined by the Engineer with a straight edge ten feet long, furnished by the Contractor. When the straight edge is laid across the seam between "new" and "old" pavement, the surface shall not vary more than 0.03 feet from the lower edge.

At join lines along new concrete gutters or where the existing asphalt pavement has been removed, the finished surface shall be from 0.03' to 0.05' higher than the concrete surface that is being joined. On existing or proposed bike routes the finished surface shall not exceed 0.02' above the gutter lip.

Median Curb (Type D-6) shall be constructed in conformance with the provisions of Section 303-5, Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps, and Driveways, of the Greenbook and these Special Provisions.

Median Curb (Type D-6) shall be constructed to the lines and grades shown on the Plans and to the details shown in City Standard No. 204A. When transitioning to an existing Median Curb the dimensions shall be modified to match the existing Median Curb.

Signing shall consist of furnishing and installing roadside signs in accordance with the Greenbook, these Special Provisions, and in accordance with the details shown on the Plans or directed by the Engineer.

Materials. The various materials and fabrication thereof shall conform to the following requirements:

Metal Posts. Sign post assemblies ("Quick Punch" or approved equal), shall consist of a 2" square non-perforated galvanized, 12 gage, steel tube with anchor assembly. The anchor assembly will consist of 2 1/4" square, galvanized, 12 gage, steel tubes 2'-6" or 3'-0" long. Galvanizing shall conform to the provisions in Section 210-3, Galvanizing, of the Greenbook.

Sign Panel Fastening Hardware. Back braces for signs shall be commercial quality, mild steel, hot-dip galvanized after fabrication.

Straps and saddle brackets for mounting sign panels on electroliers, sign structure posts and traffic signal standards or where shown on the plans shall be stainless steel conforming to the specifications of ASTM Designation: A 167, Type 302 or 304. Theft-proof bolts shall be stainless steel with a chromium content of at least 16 percent and a nickel content of at least 8 percent.

Galvanizing shall conform to the provisions in Section 210-3, Galvanizing, of the Greenbook.

Construction. The anchor assembly shall be driven into the ground such that 4"-6" remains above the ground level. In the event soft or unstable ground is encountered during installation of the anchor assembly, the Engineer may direct the Contractor to concrete the anchor assembly in place.

The sign post shall then be installed a minimum of 4"-6" into the anchor assembly and secured in place with either 2 - 5/16" x 3 1/2" carriage bolts and theft proof nuts or rivets.

The line between the center of the top of a post and the center of a post at the ground line shall be plumb within a tolerance of not to exceed 1/4" in 10'.

Sign Panel Installation. Sign panels shall be installed by the Contractor in accordance with the details shown on the plans or as directed by the Engineer. Any chipping or bending of sign panels shall be considered as sufficient cause to require replacement of panels at the Contractor's expense.

Sign panels shall be attached to metal posts, electroliers, sign structure posts, and traffic signal standards and mast arms with fastening hardware of the types and sizes shown on the plans or as directed by the Engineer. All fastening hardware shall be furnished by the Contractor. Sign panels

shall be installed to provide approximately 7' vertical clearance from finish grade to the bottom of the sign panel, unless otherwise directed by the Engineer.

Traffic Stripes and Pavement Markings shall conform to Section 84, Markings, of the Caltrans Standard Specifications, and these Special Provisions.

Striping and pavement markings, other than those called for on the plans to be installed, which are damaged or darkened as a result of the construction, including wheel markings by public traffic and the construction equipment, shall be repainted as called for in these Special Provisions at the expense of the Contractor and no additional compensation will be allowed therefor.

All stencils to be used for pavement markings shall conform to the dimensions of the standard details for pavement markings in the Caltrans Standard Plans, except that all numerals shall be 16" x 96". The numeral "1" shall be 4" x 96".

Application of the first coat of pavement delineation shall begin no sooner than three days after rolling of finished course of asphalt. The Engineer shall approve the location and alignment of all traffic stripes and pavement markings prior to application.

Temporary pavement delineation shall be installed before opening any affected travel way to public traffic.

Section 84-1.01 General

[Add the following]:

Before obliterating (or covering) any pavement delineation that is to be replaced on the same alignment and location, as determined by the Inspector, the pavement delineation shall be referenced by the Contractor, with a sufficient number of control points to reestablish the alignment and location of the new pavement delineation. The references shall include the limits or changes in striping pattern, including one- and two-way barriers lines, limit lines, crosswalks and other pavement markings. Full compensation for referencing pavement delineation shall be considered included in the contract prices paid for new pavement delineation and no additional compensation will be allowed therefor.

Unless otherwise shown, the Contractor shall re-stripe all pavement delineation to existing locations or as directed by the Engineer.

Traffic stripes shall be painted to the alignment approved by the Engineer. The Contractor shall not proceed with the alignment marking of any pavement markings and/or striping until the Engineer has checked and approved the proposed layout that shall consist of control points spaced at 200 feet maximum on tangents and 50 feet max on curves. The contractor shall have a rope or cable of adequate length available for the Engineers use in checking stripe alignment. The Engineer may make minor adjustments to the proposed alignment prior to approval.

Alignment marks may consist of cat tracking and spotting, dribble lines or an approved alternative.

Cat tracking shall consist of stretching a rope on a straight line between control points on tangent alignment and on a true arc through control points on curved alignment and placing spots of paint along the rope. The spots shall be not more than three inches in width and not more than five feet apart on curves or ten feet apart on tangents.

Dribble lines shall consist of marking the pavement with a thin line of paint using a striping machine or other suitable device. Dribble lines shall be on a straight line between control points on tangent alignment and on a true arc through control points on curved alignment.

Paint for the cat tracks and/or dribble lines shall be the same color as the traffic stripe for which they are placed.

Laser guidance equipment shall be capable of maintaining the alignment of traffic stripes with accuracy equivalent to, or better than, that obtainable through the use of cat tracking or dribble lines as determined by the Engineer.

All work necessary to establish satisfactory alignment for stripes and all layout work required for pavement markings shall be performed by the Contractor at his expense, including correction of minor irregularities in the control points approved by the Engineer. Correction of minor irregularities shall be accomplished by the application of cat tracks, the use of laser guidance devices, or by a combination of these techniques.

Only water borne paints shall be used within the City.

Pavement markers shall conform to the provisions in Section 81-3, Pavement Markers, of the Caltrans Standard Specifications and these Special Provisions.

Existing traffic stripes and pavement markings that do not conform to the plans, that are not removed or obliterated as a result of the various pavement rehabilitation operations, shall be removed in accordance with Section 84-9.03 Remove Traffic Stripes and Pavement Markings, of the Caltrans Standard Specifications and these Special Provisions.

Sandblasting shall be limited to wet sandblasting operations to control dust.

When removing pavement markings, the removal process shall be applied to a rectangular area around and covering the pavement marking, such that the resulting pavement does not exhibit a "shadowed" pavement marking. If, in the opinion of the Engineer, the removal process does not completely erase any sign of the pavement marking, the Engineer may require that the rectangular area be seal coated.

PAYMENT

The contract lump sum price for Civil Construction shall include full compensation and for furnishing all labor, materials, tools and equipment, and incidentals complete and in place as shown on the plans and as directed by the Engineer. The quantity to be paid on each progress payment will be based upon the percent complete of each line item identified in the Schedule of Values.

10-05(S) SOIL IMPROVEMENT.

This is a "Specialty Item" of work. The soil improvement item shall meet the performance criteria in the geotechnical report.

This Section covers the design, materials, equipment, labor, and execution required for installation of stone columns to improve ground conditions to meet specified performance criteria.

The work includes, but is not limited to:

1. Design of stone column ground improvement system.
2. Mobilization and site preparation.
3. Installation of stone columns.
4. Testing, quality control, and documentation.

DESIGN AND CONSTRUCTION RESPONSIBILITY

The contractor shall be solely responsible for the design, construction, and performance of the stone column system to meet the required ground improvement criteria.

Design shall be sealed by a licensed Geotechnical Engineer registered in California.

REFERENCE DOCUMENTS

The following geotechnical report is provided for reference only:

- **Title:** Geotechnical Investigation – Proposed Structures Gym & Garage with Storage
- **Prepared by:** GEOCON
- **Dated:** February 20, 2024

The report in Exhibit A includes soil borings, lab testing, and preliminary recommendations. The Contractor shall not rely solely on this report and shall conduct their own geotechnical evaluations as necessary for design.

PERFORMANCE REQUIREMENTS

The stone column system shall be designed to achieve the following minimum performance criteria:

Parameter	Requirement
Bearing Capacity	≥ 2,300 psf with soil improvement

Post-construction Settlement 1 ¾ inch total; 1 inch differential

Ground improvement shall result in a uniform, stable working platform for foundations, slabs, and other structures as defined in the construction documents.

SUBMITTALS

Submit the following for review and approval prior to mobilization:

1. **Design Report** including:
 - Design methodology and assumptions
 - Improvement layout and depth
 - Load transfer mechanisms
 - Calculated settlements and bearing capacity
 - Stone column diameter, spacing, and configuration
 - Verification that performance criteria will be met
2. **Construction Plan** including:
 - Equipment descriptions
 - Installation procedure
 - Sequence of work
 - Vibration monitoring (if applicable)
 - Layout drawings
3. **Quality Control Plan**, including:
 - Column modulus testing
 - Installation records
 - As-built verification

QUALITY ASSURANCE

A. Testing and inspection shall include, but not be limited to:

- Full-time monitoring of installation.
- Modulus or load tests (e.g., plate load test or zone load test) on selected columns.
- Post-installation documentation including depths, diameters, and stone consumption.

B. A minimum of 3 columns shall be tested to verify design assumptions.

Payment. The contract lump sum price for Soil Improvement shall include full compensation and for furnishing all design, soil analysis, labor, materials, tools and equipment, and incidentals complete and in place as shown on the plans and as directed by the Engineer. The quantity to be paid on each progress payment will be based upon the percent complete of each line item identified in the Schedule of Values.

SECTION 400 – PROTECTION AND RESTORATION.

400-1 GENERAL.

[Add the following after the second paragraph]

The contractor shall protect existing buildings, paving, curb, gutter, sidewalk, driveways, utilities, survey monuments, landscaping, irrigation, signs, pavement not designated for removal, and other services or facilities on-site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items shall be at the Contractor's expense.

[Replace the third paragraph with the following]:

Maintenance of existing electrical systems including street lighting and traffic signal systems that are damaged, temporarily removed or relocated shall be done in conformance with State Standard Specification (2018) Section 87-21.03, "Maintaining Existing Electrical Systems".

SECTION 402 – UTILITIES.

402-4 RELOCATION.

[Add the following]

Contractor shall verify utility locations prior to excavation and shall coordinate utility shutdown or facility relocations with applicable utility owners, the City and Fire Department for facilities shown or not shown on the plans to be relocated by others. Contractor shall allow sufficient time to allow for relocations during construction. Utility shutdowns affecting Fire Station operations shall not occur without prior written approval.

Some underground utilities and facilities such as electric utilities, gas utilities, telephone utilities, television utilities, street lighting facilities, traffic signal facilities, sanitary sewer, storm drains, and irrigation systems, may not have been shown on the plans for this project. The Contractor shall assume that any of these underground utilities and/or facilities may be encountered during portions of their work and shall protect and restore same in place.

The Contractor shall excavate inspection holes ("pot holes") to a depth sufficient to satisfy themselves and/or the City that the proposed construction work will not damage any underground utilities and/or facilities. The Contractor shall coordinate and cooperate with any and all utility companies in the likely event a conflicting utility is discovered and is to be relocated by the utility. Delays caused by a utility relocation should be expected, extensions of time shall be given as determined by the Engineer, and no further compensation shall be given for delays. The Contractor

shall be solely responsible for the cost of repair for any such damage to said underground facilities and shall make or cause to be made all repairs necessary to restore service the same day.

The Contractor shall coordinate the work to accommodate the relocations or adjustments to grade by the utility companies at no separate or additional cost. Full compensation for furnishing all labor, equipment, materials and tools required for compliance with the preceding requirements, including delays to utility relocation, shall be considered as being included in the various Contract items in the bid schedule and no additional compensation will be allowed therefor.

[Add the following Section]

**TECHNICAL SPECIFICATIONS
FOR
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**

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END OF SECTION

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use form provided at end of this Section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall

Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven calendar days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 calendar days of receipt of request, or seven calendar days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 calendar days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.

- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 calendar days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

REQUEST FOR SUBSTITUTION

The undersigned Contractor requests consideration of the following request for substitution:

Date:

Project Name:

Specified Product:

Section Number:

Section Title:

Part, Article, Paragraph:

Description of specified work:

Requested Substitution: (Include product data and supplemental information as requested by the Architect)

Manufacturer's Certification:

The undersigned represents the manufacturer of the requested substitution and hereby certifies and warrants that the function and quality of the requested substitution is equivalent or superior to the specified work.

manufacturer's representative name and signature

date

company

Documentation:

☐ Applicable information required by Specification Section 012500 - Substitution Procedures is part of this request.

Contractor's Acceptance:

The undersigned certifies the Proposed Substitution complies with requirements of Section 01 25 00 - Substitution Procedures.

Change to Contract Sum: \$ _____ ☐ Decrease ☐ Increase

Change to Contract Time: ☐ Adds _____ calendar days ☐ Deletes _____ calendar days ☐ Has no impact

Reason for Substitution: ☐ Substitution for Cause ☐ Substitution for Convenience

contractor's name and signature

date

company

Architect's Action:

☐ Recommends acceptance ☐ Does not recommend acceptance
☐ Returned - Request does not comply with specified requirements

Architect's name and signature

date

company

Owner's Action:

☐ Accepts ☐ Does not accept

Owner's name and signature

date

company

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.
1. Minor Changes in the Work.
 2. Proposal Requests.
 3. Administrative Change Orders.
 4. Change Order procedures.
 5. Construction Change Directive.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue an Architect's Supplemental Instructions on AIA Document G710 authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 2. Within 20 calendar days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012900
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.
 - 1. Schedule of Values.
 - 2. Applications for Payment.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven calendar days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.

- b. Description of the Work.
- c. Name of subcontractor.
- d. Name of manufacturer or fabricator.
- e. Name of supplier.
- f. Change Orders (numbers) that affect value.
- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
- 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
- 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 7. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
- 8. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 9. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
- 11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the time of the month specified in the Preconstruction Conference. The period covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment seven calendar days prior to due date for review by Architect.

- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Division 01 Section "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.
 12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative provisions for coordinating construction operations.

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

1.2 SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 calendar days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven calendar days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within seven calendar days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at Progress Meetings. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven calendar days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and CAD drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
- B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.

- c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 2. Provide Project management software user licenses for use of Owner, Architect, and Architect's consultants. Provide software training at Architect's office for web-based Project software users.
 3. At completion of Project, provide digital archive in PDF format. Provide data in locked format to prevent further changes.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven calendar days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three calendar days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 working days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner; Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:

- a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements, if any.
 - o. Preparation of Record Documents.
 - p. Use of the premises.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 calendar days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner; Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation, if any.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.

- h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation, if any.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for documenting the progress of construction during performance of the Work.
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

1.2 SUBMITTALS

- A. Format for Submittals: Submit required submittals in PDF format.
- B. Startup construction schedule.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Unusual Event Reports: Submit at time of unusual event.

1.3 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity with other activities and schedule them in proper sequence.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 10 working days, unless specifically allowed by Architect.
 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.

- g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
- 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. When revisions are made, distribute updated schedules to the same parties. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. Approximate count of personnel at Project site.
 3. Equipment at Project site.
 4. Material deliveries.
 5. High and low temperatures and general weather conditions, including presence of rain or snow.
 6. Testing and inspection.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one calendar day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for submittals.

1. Submittal schedule requirements.
2. Submittal formats.
3. Submittal procedures.
4. Submittal requirements.
5. Contractor's review.
6. Architect's review.

1.2 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as a submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Name of subcontractor.
 - d. Description of the Work covered.
 - e. Scheduled date for Architect's final release or approval.

1.3 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Submittal purpose and description.
9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
10. Drawing number and detail references, as appropriate.
11. Indication of full or partial submittal.
12. Location(s) where product is to be installed, as appropriate.
13. Other necessary identification.
14. Remarks.
15. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.4 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections. Submit according to one of the following:
 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, 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. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect'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 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 calendar days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 calendar days for initial review of each submittal.
 - 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 calendar days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.5 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect manufacturer's technical product information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog product data.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.

- f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.6 CONTRACTOR'S REVIEW

- A. Submittal Review: 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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or an indication in web-based Project management software. Include 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.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.7 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Architect will return without review submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.
 - 1. Delegated design or engineering services.
 - 2. Testing and inspection services.
 - 3. Conflicting requirements.
 - 4. Submittals.
 - 5. Contractor's Quality-Control Plan.
 - 6. Reports and documents.
 - 7. Quality Assurance.
 - 8. Quality Control.
 - 9. Special Tests and Inspections.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN OR ENGINEERING SERVICES

- A. Performance and Design or Engineering Criteria: Where professional design or engineering 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.
- B. Delegated Design or Engineering Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or engineered or certified by a design professional, indicating that the products and systems are in compliance with performance and design or engineering criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 TESTING AND INSPECTION SERVICES

- A. General: Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 SUBMITTALS

- A. Mockup Shop Drawings:
1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
 2. Indicate manufacturer and model number of individual components.
 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- C. Qualification Data: For Contractor's quality-control personnel.
- D. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.
- 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN
- A. Quality-Control Plan, General: Submit quality-control plan within 10 calendar days of Notice to Proceed, and not less than five calendar days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent or someone who does not have other Project responsibilities.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection:
1. In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - a. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - b. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - c. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well

as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E699, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
 - 1. Provide test specimens representative of proposed products and construction.
 - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 - 5. When testing is complete, remove test specimens and test assemblies; do not reuse products on Project.
 - 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests

and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Notify Architect seven calendar days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven calendar days for initial review and each re-review of each mockup.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 10. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances specified in Division 01 Section "Allowances," as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.

- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
 - 1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 - 2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 014200
REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for the following:
1. Temporary utilities.
 2. Support facilities.
 3. Security and protection facilities.

1.2 USE CHARGES

- A. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 SUBMITTALS

- A. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- B. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste-handling procedures.
 5. Other dust-control measures.
- C. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Methods used to meet the goals and requirements of the Owner.
 2. Concrete cutting method(s) to be used.
 3. Location of construction devices on the site.
 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Accessible Temporary Egress: Comply with applicable accessibility provisions identified on the Drawings.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4 foot square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 degrees F.
 - 5. Lighting fixtures capable of maintaining average illumination of 20 foot-candles at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Connect to existing service.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide safety shower, eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

- E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- F. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- B. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- C. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Division 01 Section "Execution."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

- E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION

SECTION 016100
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for following:

1. Product delivery, storage, and handling.
2. Product warranties.
3. Product selection procedures.
4. General installation provisions.

1.2 DEFINITIONS

- A. Products: Term "product" includes terms "material," "equipment," "system," "component," and terms of similar intent.
- B. Hazardous Substances Prohibited by Law: Including, but not limited to, any product, material, element, constituent, chemical, substance, compound, or mixture, which is defined in, included under, or regulated by any environmental laws.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between 2 or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Restriction of Hazardous Substances Compliance: Contractor shall take whatever measures deemed necessary to insure that employees, suppliers, vendors, fabricators, subcontractors, or their assigns, comply with restriction requirements for hazardous substance.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.

2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.5 PRODUCT WARRANTIES

- A. General: Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with Specifications, prepare a written document using indicated form properly executed.
 3. Refer to individual Specification Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. If standard products are available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves right to limit selection to products with warranties not in conflict with requirements of Contract Documents.
 4. Where products are accompanied by term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
 6. Use of phrase "or equal" shall be defined as "or equivalent as judged by Architect."
- B. "Acceptable Manufacturers" or "Acceptable Manufacturers and Products":
 1. Where Specifications include a list of named manufacturers and products that are acceptable, provide any product from that list that complies with requirements of Contract Documents.

2. Manufacturers and products that can be used are restricted to those on list.
 3. Manufacturers and products not included on list are considered substitutions.
- C. "Available Manufacturers" or "Available Manufacturers and Products":
1. Where Specifications include a list of named manufacturers and products that are known to be available, provide any product from that list, or a product from an unnamed manufacturer, that complies with requirements of Contract Documents.
 2. Manufacturers and products that can be used are not restricted to those on list.
 3. Manufacturers and products not included on list are not considered substitutions.
- D. "Basis of Design":
1. Use of phrase "Product Standard" or similar phrase shall be defined as "Basis of Design."
 2. When Specifications name a single manufacturer and product, it is to establish significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics, for purposes of evaluating other named manufacturers and products. Drawings and Specifications indicate and specify characteristics that are based on "Basis of Design" manufacturer and product. Other acceptable or available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and does not change intent of Contract Documents as judged by Architect.
 3. If Specification includes a list of "Acceptable Manufacturers" or "Acceptable Manufacturers and Products," provide named "Basis of Design" product or any product from that list that complies with requirements of Contract Documents.
 4. If Specification includes a list of "Available Manufacturers" or "Available Manufacturers and Products," provide named "Basis of Design" product or any product from that list, or a product from an unnamed manufacturer, that complies with requirements of Contract Documents.
 5. If Specification does not include a list of either "Acceptable Manufacturers and Products" or "Available Manufacturers and Products," any product that complies with requirements of Contract Documents may be used.
- E. "Required Manufacturer" or "Required Manufacturer and Product":
1. Where Specifications name a single, required manufacturer and product, only that manufacturer and product may be used.
 2. Any other manufacturer and product is considered a substitution.
- F. Visual Matching Specification: Where Specifications include phrase "match Architect's sample" or similar phrase, provide a product that complies with requirements of Contract Documents and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- G. Visual Selection Specification: Where Specifications include phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

- A. Manufacturer's Instructions:

1. Comply with manufacturer's installation instructions and recommendations, to extent that instructions and recommendations are more explicit or stringent than requirements in Contract Documents.
 2. Handle, install, connect, clean, condition and adjust products according to manufacturer's instructions and in conformity with specified requirements.
 - a. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with manufacturer for further instructions.
 - b. Do not proceed with Work without clear instructions.
 3. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by manufacturer.
- B. Product Inspection: Inspect products immediately upon delivery and again prior to installation. Reject damaged and defective items.
- C. Weather Conditions: Install each component during weather conditions and Project status that will ensure best possible results. Isolate each part of completed construction from incompatible product or material as necessary to prevent deterioration.

END OF SECTION

SECTION 017300
EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Coordination of Owner's portion of the Work.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls and floors for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

- B. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Division 01 Section "Project Management and Coordination."

3.3 INSTALLATION OF THE WORK

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Select tools or equipment that minimize production of excessive noise levels.
- G. Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.4 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.5 PROGRESS CLEANING

- A. Clean project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017329
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General administrative and procedural requirements governing cutting and patching.

1.2 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

- A. Cutting and Patching Plan: Submit a plan describing procedures for major cutting and patching at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
1. Extent: Describe cutting and patching, show how it will be performed, and indicate why it cannot be avoided.
 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 3. Products: List products to be used and firms or entities that will perform the Work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 7. Architect's Approval: Obtain approval of cutting and patching plan before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include, but are not limited to, the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include, but are not limited to, the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements:
 - a. Do not cut and patch construction in a manner that results in visual evidence of cutting and patching.
 - b. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.
 - c. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Cutting and Patching Conference: Conduct conference at Project site.
1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Specification Sections.
- B. Existing Materials:
 - 1. Use materials identical to existing materials.
 - 2. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 3. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 2. Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Division 01 Section "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall

and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

END OF SECTION

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.
- D. Certificates of Release: From authorities having jurisdiction.
- E. Certificate of Insurance: For continuing coverage.
- F. Field Report: For pest-control inspection.
- G. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list").
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 working days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.

3. Submit closeout submittals specified in individual Sections, including specific warranties, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 5. Submit testing, adjusting, and balancing records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 working days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 working days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.
- 1.5 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Division 01 Section "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 working days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.6 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
4. Submit list of incomplete items in one of the following formats:
 - a. PDF Electronic File: Architect will return annotated file.
 - b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 working days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit **[on digital media acceptable to Architect] [by uploading to web-based project software site] [by email to Architect]**.

- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in [**Section 015000 "Temporary Facilities and Controls."**] [**Section 017419 "Construction Waste Management and Disposal."**]
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations required by Division 01 Section "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for Project Record Documents, including the following:

1. Record drawings.
2. Record specifications.
3. Maintenance of Record Documents.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

- 1) Submit PDF electronic files of scanned record prints.
- 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

- 1) Submit PDF electronic files of scanned Record Prints.
- 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
- b. Accurately record information in an acceptable drawing technique.
- c. Record data as soon as possible after obtaining it.
- d. Record and check the markup before enclosing concealed installations.
- e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

- a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - 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 or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit record specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for

construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 030516**UNDERSLAB VAPOR BARRIER****PART 1 GENERAL****1.01 SUMMARY**

- A. Section includes:
 - 1. Sheet vapor barrier under concrete floor slabs on grade.
- B. Related Requirements:
 - 1. Section 03 3000 – Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.02 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m² Pa)), maximum.
 - 2. Complying with ASTM E1745 Class A.
 - 3. Thickness: 15 mils (0.4mm)
 - 4. Basis of Design:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil):
www.stegoindustries.com
 - 5. Acceptable Products:
 - a. Fortfiber Building Systems Group; Moisture Stop Ultra 15.
 - b. GCP Applied Technologies Inc.; FlorPrufe 120.
 - c. ISI Building Products; Viper VaporCheck II 15-mil (Class A)
 - d. Raven Industries, Inc.; VaporBlock 15.
 - e. Reef Industries, Inc.; Griffolyn Green 15.

- f. WR Meadows, Inc.; Perminator 15 mil.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, boots, etc. for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Installation of system indicates acceptance of surfaces and conditions.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches (150 mm). Tape all joints with manufacturer provided seam and joint tape.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Utilize premanufactured penetration boots by vapor barrier manufacturer.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

3.03 FIELD QUALITY CONTROL

- A. Provide inspection of installed vapor barrier following reinforcing steel installation and prior to concrete placement. Repair damaged or improperly installed areas of vapor barrier in accordance with manufacturer recommendations at no additional cost to the Owner. Provide written and photographic report of repair areas before and after completion of repairs.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Floors and slabs on grade.
- C. Grade beams and footings.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads.
- G. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 033511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- B. Section 079200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.
- C. Section 079513 - Expansion Joint Cover Assemblies.
- D. Section 321313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2015.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 2022.
- C. ACI 301 - Specifications for Structural Concrete; 2020.
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- F. ACI 305R - Hot Weather Concreting; 2020.
- G. ACI 306R - Cold Weather Concreting; 2016.
- H. ACI 308R - Guide to Curing Concrete; 2016.
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2019
- J. ACI 347R - Guide to Formwork for Concrete; 2014.
- K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- M. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- N. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- O. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2016b.
- P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

- Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- R. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- S. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- T. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2022.
- U. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- V. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.
- W. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 2020.
- X. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- Y. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit the proposed concrete mix design.
 - 1. Indicate proposed mix design complies with the requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing, and Placing.
- D. Samples: Submit samples of under-slab vapor retarder to be used.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with the tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Coating: Release agent that will not adversely affect concrete or interfere with the application of coatings.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 age, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for adequate support of

reinforcement during concrete placement.

3. Provide stainless steel, galvanized, plastic, or plastic-coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
 1. Acquire all cement for the entire project from the same source.
- B. Fine and Coarse Aggregates: ASTM C 33.
 1. Acquire all aggregates for the entire project from the same source.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- C. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by the manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single-ply polyethylene is prohibited.
 1. Installation: Comply with ASTM E1643.
 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarders.
 3. Manufacturers:
 - a. Stego Industries, LLC: www.stegoindustries.com.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water-reducing, and plasticizing agents.
 1. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-dispersible acrylic latex, complying with ASTM C1059/C1059M, Type II.
- B. Epoxy Bonding System:
 1. Complying with ASTM C881/C881M and of Type required for specific applications.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with a removable top section that will form a 1/2 inch deep sealant pocket after removal.
- D. Slab Contraction Joint Device: Performed linear strip intended for pressing into wet concrete to provide a straight route for shrinkage cracking.

2.07 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- C. Curing Agent, Water Replacement Type: Clear, water-based, liquid water cure replacement agent complying with ASTM C309 standards for water retention, and with ACI 302.1R.

- D. Moisture-Retaining Sheet: ASTM C171.
 - 1. White-burlap-polyethylene sheet, weighing not less than 10 ounces per linear yard, 40 inches wide.
- E. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Concrete Strength: Establish the required average strength for each type of concrete based on field experience or trial mixtures, as specified in ACI 301.
 - 1. For the trial mixtures method, employ an independent testing agency acceptable to the Architect for preparing and reporting proposed mix designs.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by the manufacturer.
- C. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Water-Cement Ratio: Maximum as indicated on drawings percent by weight.
 - 4. Maximum Slump: as indicated on drawings inches.
 - 5. Maximum Aggregate Size: as indicated on drawings (inch).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with the work of this section.

3.02 PREPARATION

- A. Formwork: Comply with the requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying a release agent.
- C. Coordinate placement of embedded items with the erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare the existing surface by cleaning it with a steel brush and applying a bonding agent in accordance with the manufacturer's instructions.
 - 1. Use an epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agents only for non-load-bearing applications.
- E. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams, and penetrations watertight with the manufacturer's recommended products and follow the manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing the vapor retarder as shown on the drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than the minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in the maximum possible lengths and offset end laps in both directions. Splice laps with tie wire.

- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify the Architect not less than 48 hours before commencement of placement operations.
- D. Maintain records of concrete placement. Record the date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, water stops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary before the next placement prepare the joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting. See drawings for additional joint preparations as required.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

- A. Locate joints as indicated on the drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with a removable top section for joint sealant, total height equal to the thickness of the slab, set flush with the top of the slab.
- D. Saw Cut Contraction Joints: Saw cut joints before the concrete begins to cool, as indicated on the drawings.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
 - 1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
 - 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
 - 3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
 - 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
- B. Measure F(F) and F(L) in accordance with ASTM E1155, within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- C. Correct the slab surface if the composite overall value is less than specified and if the local value is less than two-thirds of the specified value or less than F(F) 13/F(L) 10.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

- A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with a full bed setting system.
 - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces

include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.

3.08 CURING AND PROTECTION

- A. Comply with the requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for the hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than 7 days.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers before use or remove the surface coating after curing to the flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before the surface is dry. Keep continuously moist for not less than three days with water-fog spray or saturated burlap.
 - a. Spraying: Spray water over floor slab areas and maintain wet.
 - b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 - 3. Final Curing: Begin after initial curing but before the surface is dry.
 - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
 - b. Curing Compound: Apply in two coats at right angles, using the application rate recommended by the manufacturer.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at the project site and cooperate with the appointed firm.
- C. Submit the proposed mix design of each class of concrete to the inspection and testing firm for review before the commencement of concrete operations.
- D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples as required per ACI 318 Section 5.6 and in accordance with ASTM C172/C172M.
- E. Take one additional test cylinder during cold weather concreting, cured on the job site under the same conditions as the concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to the Architect and Contractor within 24 hours of the test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by the Contractor when defective concrete is identified.

- D. Do not patch, fill, touch up, repair, or replace exposed concrete except upon the express direction of the Architect for each individual area.

3.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surfaces until fully cured.

END OF SECTION

SECTION 033500
CONCRETE FINISHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

1.03 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's product data and installation specifications for manufactured products. Include material characteristics and properties, including compatibility or non-compatibility with applied adhesives and floor finish materials.

1.04 QUALITY ASSURANCE

- A. Applicable standards of the following, as referenced herein:
- B. Applicator certification:
- C. Manufacturer's certification: Provide a letter of acknowledgment from both the equipment and chemical manufacturer stating that the installer is a trained applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.

1.05 PROJECT / SITE CONDITIONS

- A. Maintain temperature of concrete above 50 degrees F for seven days after placing. Protect work against frost, rapid drying and heavy rain.

PART 2 PRODUCTS

2.01 APPLICATIONS – MOISTURE CURING MATERIALS FOR CONCRETE

- A. For use at concrete designated to receive additional floor covering and coatings.
- B. Coordinate with individual project floor finish product requirements.

2.02 SHEET MATERIALS

- A. Synthetic fiber/plastic sheet moisture-retaining cover:
 - 1. Acceptable products:
 - 2. Material: White synthetic fiber matting securely attached to white plastic sheet backing; meeting ASTM C171.

3. Ensure that multiple-use sheet are clean, serviceable, functional and approved for use by the Engineer. Replace sheets that are not acceptable to Engineer.
4. Ensure that single-use sheets are new and used only one time.
5. Water: Clean, potable, free of alkali, acid, oil or organic matter.

2.03 CURING COMPOUNDS

A. Dissipating Membrane Forming Curing Compound:

1. Type: Dissipating clear, water-borne, membrane forming curing compound. ASTM C309, Type 1, Class B, dissipating.
2. Compatibility with floor finishes:
 - a. Compound shall be compatible with bonding of various floor covering finishes required for the project.
 - b. If compound is not compatible with final floor covering finishes, Contractor shall remove compound by shot-blasting or other approved methods immediately prior to final floor covering finish installation.
3. Acceptable Products:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. Burke by Edoco; Aqua Resin Cure.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - f. Euclid Chemical Company (The); Kurez DR VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; Aqua Kure-Clear.
 - i. L&M Construction Chemicals, Inc.; L&M Cure R.
 - j. Meadows, W.R., Inc.; 11500 Clear.
 - k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
 - l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
 - m. Tamms Industries, Inc.; Horncure WB30.
 - n. Unitex; Hydro Cure 309.
 - o. US Mix Products Company; US Spec Maxcure Resin Clear.
 - p. Vexcon Chemical, Inc.; Certi-Vex Enviocure 100.

B. Non-dissipating Curing Compound:

1. Applications: For use at concrete designed to receive additional floor coverings, coatings, and floor finishes; excluding tile, resinous flooring, membranes and coatings.
2. Type: Non-dissipating clear, water-borne curing compound, non-yellowing.
3. Compatibility with floor finishes:
 - a. Compound shall be compatible with bonding of various floor covering finishes required for the project.
 - b. If compound is not compatible with final floor covering finishes, Contractor shall remove compound by shot-blasting or other approved methods immediately prior to final floor covering finish installation.
4. Acceptable products:
 - a. Basis of Design: Laticrete International, Inc., L&M Construction Chemicals, Inc., Dress & Seal WB; www.laticrete.com
 - b. Anti-Hydro International, Inc., A-H Clear Cure WB.
 - c. BASF Building Systems, MasterKure CC 160 WB.
 - d. Euclid Chemical Co., Aqua Cure VOX, Clearseal WB 150.
 - e. Lambert Corp., Glazecoat Sealer – 20.
 - f. W.R. Meadows Co., Vocomp-20.
 - g. Nox-Crete Products Group/Kinsman Corp., Cure & Seal 150E.

2.04 CONCRETE SEALING COMPOUND

- A. Applications: For interior or exterior exposed concrete sealing use at concrete designated to receive no additional finishes.
 1. Not for use as a curing compound.
 2. Shall be applied over smooth steel troweled surface exposed concrete slab finish.
- B. Product: Refer to Section 09 9000 – Painting and Coating.

2.05 CONCRETE BONDING AGENT

- A. Applications: Acrylic polymer emulsion used either as a bonding adhesive or as an admixture for concrete repairs to enhances Portland cement-based mixes, giving the mixes improved flexural, tensile, and bond strength.
 1. Used as an additive for Portland cement-based repair mortars to increase adhesion, freeze-thaw resistance, flexural strength and durability.
 2. Used as a bonding agent, to become an integral part of the interface between the cementitious material and the surface to be bonded.

B. Characteristics:

1. Milky white, high solids emulsion that will not re-emulsify upon exposure to water, and is non-oxidizing and ultra-violet stable.
2. Can be used over new concrete, existing concrete, brick, concrete block (CMU), clay tile, marble, and glass block.

C. Acceptable Products:

1. Basis of Design: Laticrete International, Inc., L&M Construction Chemicals, Inc., Everbond; www.laticrete.com
2. Anti-Hydro International, Inc., A-H Anchor-It.
3. Euclid Chemical Co., Flex-Con.
4. Lambert Corp., Acrylbond.
5. Larsen Products Corp., Weld-Crete.
6. W.R. Meadows, Intralok.

PART 3 EXECUTION**3.01 EXAMINATION****A. Coordination:**

1. Coordinate with floor finish requirements of individually specified floor finish systems.
2. Comply with floor flatness and levelness tolerances as specified in Cast-in-Place Concrete section, except as specified herein.

B. General:

1. Screed floor slabs to even surface by use of straightedge and screeding strips, within tolerances prescribed by ACI 302.1R and ACI 117 for specified slab finish.

C. Finishing tolerances: Surfaces shall meet the following tolerances, unless more stringent tolerances are specified in Cast-In-Place Concrete section.

1. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface exceeding 360 square feet and 8 feet in width:
 - a. Unless noted otherwise, specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness F(L) 15.
 - b. At floors to be covered with resilient flooring, resinous flooring, athletic flooring, or other thin-fil finish coating systems, excluding tile, specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 23; and of levelness, F(L) 17.
 - c. F(L) levelness shall not apply to slabs placed on unshored formed surfaces.

- d. Concrete slabs on steel deck shall be placed at a constant thickness, with a thickness tolerance of +1/2 inch, -1/4 inch.
 - e. Provide entire top of formed slabs, before removal of shoring, within +/- 1/4 inch of the top of slab elevation shown on Drawings.
- 2. Finish sloped surfaces and surfaces less than or equal to 360 square feet or 8 feet in width within +/- 1/4 inch in 10 feet (as measured by placing a freestanding (unleveled) 10 ft. straightedge anywhere on the slab and allowing it to rest upon two high spots with a maximum gap of 1/2 inch within 72 hr after slab concrete placement).
- 3. Allowable tolerances for thin-set and LHT (medium bed set) tile installations: Plumb, level and true to line, meeting ANSI A108.02 as follows:
 - a. For tile with all dimensions less than 15 inches: Maximum 1/16 inch in 12 inches and maximum 1/4 inch in 10 feet.
 - b. For tile with any dimension greater than 15 inches: Maximum 1/16 inch in 2 feet and maximum 1/8 inch in 10 feet.
- D. Finishes for concrete to receive waterproofing and roofing:
 - 1. Comply with each manufacturer's product data for float, trowel, light trowel and/or light or fine broom finish.
 - 2. Concrete to receive waterproofing and roofing toppings shall be moisture cured.
- E. Float finish:
 - 1. Float surface of concrete with steel/magnesium tools for fibrous concrete, with wood float finish for other concrete.
 - 2. Float in manner which will compact concrete and produce surface free of depressions or ridges.
 - 3. Test for grade or level and correct as necessary by removing excess or adding and compacting additional concrete.
 - 4. For thick-bed (mortar bed) ceramic tile installations and self-leveling methods: Maximum allowable variation in the installation substrate shall be 1/4 inch in 10 feet.
- F. Trowel finish: Apply trowel finish to designated monolithic slab surfaces.
 - 1. After floating, begin first trowel finish operation using power-driven trowel.
 - 2. Begin final troweling when surface produces ringing sound as trowel is moved over surface.
 - 3. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with surface plane tolerances not exceeding 1/8 inch in 10 feet when tested with a 10 foot straight edge.
 - 4. The following surface shall receive a trowel finish:
 - a. Surfaces to be exposed in the finished work, except where designated to receive a non-slip broom finish.

- b. Surfaces to receive applied membranes and coatings.
 - c. Surfaces to receive other adhesive-set finish flooring materials, excluding thin-bed set tile and stone.
- G. Trowel and light broom finish: Thin-bed set tile and stone tile surfaces shall receive a steel trowel and light broom finish, in accord with the Tile Council of North America (TCNA) methods and ANSI A108.01.
 - 1. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a light broom finish.
 - 2. Maximum allowable variation in the tile installation substrates shall not exceed the floor flatness tolerances as specified in Cast-in-Place Concrete section or the TCNA / ANSI tolerances as follows, whichever is more stringent:
 - a. Substrate tolerances for thin-bed set and LHT (medium bed) tile installations, excluding epoxy adhesive:
 - 1) For tiles with all edges shorter than 15 inches, maximum allowable variation shall be $\frac{1}{4}$ inch in 10 feet from the required plane, with no more than $\frac{1}{16}$ inch variation in 12 inches when measured from the high points in the surface.
 - 2) For tiles with at least one edge 15 inches in length, maximum allowable variation shall be $\frac{1}{8}$ inch in 10 feet from the required plane, with no more than $\frac{1}{16}$ inch variation in 24 inches when measured from the high points in the surface.
 - b. Substrate tolerances for thin-bed stone tile installations: Maximum allowable variation shall be $\frac{1}{8}$ inch in 10 feet from the required plane, with no more than $\frac{1}{16}$ inch variation in 24 inches when measured from the high points in the surface.
 - c. Substrate tolerances for thin-bed ceramic tile installation when epoxy adhesive is used: Maximum allowable variation shall be $\frac{1}{16}$ inch in 3 feet with no abrupt irregularities greater than $\frac{1}{32}$ inch.
- H. Non-slip broom finish:
 - 1. Immediately after trowel finishing, roughen concrete surface by brooming in direction perpendicular to main traffic route.
 - a. Coordinate required final finish with Architect before application.
 - 2. Apply non-slip broom finish to exterior concrete platforms, steps and ramps.
 - 3. For fiber reinforced concrete, pull broom in one direction only.

3.02 FORMED WALL FINISHES

- A. Formwork irregularities: Permitted abrupt or gradual irregularities in formed surfaces, as measured with a 5 foot length with a straightedge; limit concrete surface irregularities as a result of formwork, designated by ACI 347 Guide to Formwork for Concrete, as follows:
 - 1. Class A: $\frac{1}{8}$ inch.

2. Class B: ¼ inch.
3. Class C: ½ inch.
- B. Class C “As-Cast” finish: Provide “as-cast” finish to concrete formed surfaces that are to be concealed in finish work or by other construction.
 1. Finish shall be the concrete surface having texture imparted by form facing material.
 2. Remove fins and other projections exceeding ¼ inch in height.
- C. Class B Smooth Formed Finish: For walls exposed to view in public and non-public, non-conditioned spaces.
 1. Fins and similar defects shall be totally removed.
 2. Patch tie holes and defects.
- D. Class A Smooth Rubbed Finish: For unfinished walls exposed to view in public, conditioned spaces, and for all walls to receive finishes.
 1. Edges shall be straight and square. Patch tie holes.
 2. Achieve finish by rubbing surface with Caborundum stone and water to achieve a smooth finish uniform in color and texture. Slush coat of cement grout or cement wash shall not be used at any stage of this finish.
- E. Related unformed surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

3.03 CURING / SEALING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at relatively constant temperature for the period of time necessary for hydration of cement and hardening of concrete.
- B. Begin initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep concrete continuously moist for not less than 72 hours.
- C. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive), during which the concrete has been exposed to air temperatures above 50 degrees F. Avoid rapid drying at the end of final curing period.
- D. Curing methods: Cure concrete by moisture curing or by applying specified curing and sealing compounds, with specific applications listed below. Apply manufactured products in accord with manufacturer’s product data.
 1. Cure surfaces to receive polished and stained concrete finishes and surfaces to receive membrane or coating materials applied directly to the concrete by moisture curing method only. Do not use curing, sealing, or hardening compounds.

2. Cure interior floor surfaces to receive athletic flooring, resinous flooring, tile, and other materials directly bonded to concrete by moisture curing method only. Do not use curing, sealing, or hardening compounds.
 3. Cure interior floor surfaces to receive other types of finished floors, including resilient tile and carpet, using specified non-dissipating curing and sealing compound compatible with floor finish installation.
 4. Cure interior floor surfaces which are not designated to receive further finish with specified curing and sealing compound.
- E. Provide moisture curing by any of the following methods:
1. Keep surface of concrete continuously wet by covering with water.
 2. Continuously water-fog spray.
 3. Cover concrete surfaces with specified moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Apply membrane curing/sealing compounds as follows:
1. Apply specified curing and sealing compound to damp concrete surfaces as soon as the concrete has set sufficiently so as not to be marred by the application.
 2. Re-coat areas which are subjected to heavy rainfall within three hours after initial application.
 3. Maintain continuity of coating, and repair damage to coat during entire period.
 4. Do not use membrane curing and sealing compounds on surfaces indicated to be covered with a coating or membrane material applied directly to the concrete. Use moisture curing methods for these applications.
- G. Cure formed surfaces of concrete, including undersides of supported slabs and other similar surfaces by moist-curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- H. Curing unformed surfaces:
1. Initially cure unformed surfaces, such as slabs and other flat surfaces, by moisture curing.
 2. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

3.04 PATCHING OF EXPOSED CONCRETE SURFACES

- A. Areas requiring patching shall not exceed two sq. ft. per 1000 sq. ft. of surface area and shall be widely dispersed. Areas having excessive defects, as determined by Architect, shall be removed and replaced.

- B. Following finishing operation, patch voids, honeycombs, form tie holes and defects using a mixture of similar proportions to original concrete, deleting coarse aggregate.
- C. In preparing areas to receive patch, remove loose particles and chip out adjacent sound concrete to avoid feather-edged patches. Patches shall match approved patches on mock-up.
- D. Apply a coating of bonding agent to areas being patched. Take care to prevent staining of exposed surfaces. Apply bonding agent in accord with manufacturer's product data.
- E. Fill in area with selected mix, bringing to same level as original concrete. Brush out area to match surrounding work. Allow to cure.

3.05 PROTECTION

- A. Protect freshly placed concrete from damage due to water, falling object or persons marring finish surface of concrete. Surfaces damaged due to lack of protective measures shall be removed and replaced with fresh concrete.
- B. Protect finished surfaces from damage by work of other trades due to subsequent work.
- C. Protect floor surfaces to be left exposed from damage during subsequent construction operations and make necessary repairs to damaged area, returning to original condition.

END OF SECTION

SECTION 042200
CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concrete masonry units.
 2. Related materials necessary for installation.

1.2 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells for loadbearing assemblies designed by Structural Engineer to support axial (gravity) loads and lateral (wind/seismic) loads.
- B. Masonry Terminology: Refer to NCMA TEK 1-4 and other referenced quality standards.

1.3 SUBMITTALS

- A. Product Data: Manufacturers technical literature for each type of product indicated, specified, or required.
- B. Shop Drawings: Dimensioned drawings, plans, elevations, and details of products to be incorporated into Work including, but not limited to, following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced masonry assemblies.
 3. Anchors, Ties and Accessories: Show sizes, coursing, and locations.
- C. Statement of Compressive Strength of Reinforced Masonry: Statement of average net-area compressive strength for each combination of masonry unit type and mortar type and resulting net-area compressive strength of masonry.

1.4 QUALITY ASSURANCE

- A. Masonry Installer Qualifications:
1. Experience: Installer with minimum of 10 years' specialized experience installing Work similar to scope of Project and having record of successful in-service performance.
 2. Supervision: Installer shall maintain a competent supervisor who is on job site during times specified Work is in progress and who has minimum 10 years' experience in installing systems similar to type and scope required for Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Label pallets of masonry units with manufacturers name, product name, and information required to identify products.
- B. Storage:

1. Masonry Units: Store on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
2. Cementitious Materials: Store on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
3. Accessories: Store to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection During Work: Prevent excess moisture from entering Work in progress.
 1. Cover tops of walls, projections, and sills with water-repellent tarps or heavy plastic sheets at end of each day's Work.
 2. Cover partially completed masonry when construction is not in progress.
 3. Extend cover minimum of 24 inches down both sides and hold cover securely in place.
 4. Protect door frames from damage.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Hot and Cold Weather Requirements: Comply with building code or TMS 602/ACI 530.1/ASCE 6 whichever is more stringent, and following:
 1. Do not use frozen materials or materials mixed or coated with ice or frost.
 2. Do not build on frozen substrates.
 3. Remove and replace masonry damaged by frost or freezing conditions.
 4. Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on products specified under each item below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change design intent as judged by Architect.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

2.2 PERFORMANCE REQUIREMENTS

- A. Reinforced Masonry:

1. Provide reinforced masonry that develops net-area compressive strengths (f_m) at 28 days indicated on Structural Drawings.
2. Determine net-area compressive strength (f_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method).

2.3 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Cementitious Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Shapes: Provide shapes indicated and as follows for each form of unit required:
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for outside corners, unless otherwise indicated.
- E. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 STANDARD CONCRETE MASONRY UNITS

- A. Product Quality Standard: ASTM C90, with following physical properties:
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 pounds per square inch for 3 units and minimum 1800 pounds per square inch for individual unit.
 2. Weight Classification: Normal weight.
 3. Size (Width): Manufactured to dimensions 3/8 inches less than nominal dimensions.
 4. Exposed Faces: Manufacturer's standard.

2.5 LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I; blended cement according to ASTM C595, 1L; except Type III may be used for cold-weather construction; natural gray.

- B. Hydrated Lime: ASTM C207, Type S.
- C. Other Types of Cement: Permitted only if the mix is portland cement and hydrated lime without other ingredients:
 - 1. ASTM C91 masonry cement.
 - 2. ASTM C1329 mortar cement.
- D. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C404.
- F. Water: Potable.

2.7 JOINT REINFORCEMENT

- A. Masonry Joint Reinforcement, General:
 - 1. Product Quality Standard: ASTM A951.
 - 2. Interior Walls: Mill galvanized, carbon steel.
 - 3. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 4. Wire Size for Side Rods: One of following diameters as indicated on Drawings, required by building code, or required by TMS 602/ACI 530.1/ASCE 6:
 - a. W1.7 or 9 gauge (0.148 inch).
 - b. W2.8 or 3/16 inch (0.188 inch).
 - 5. Wire Size for Cross Rods: One of following diameters as indicated on Drawings, required by building code, or required by TMS 602/ACI 530.1/ASCE 6:
 - a. W1.7 or 9 gauge (0.148 inch).
 - b. W2.8 or 3/16 inch (0.188 inch).
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches on centers.
 - 7. Lengths: Not less than 10 feet, with prefabricated corner and tee units.
- B. Basis of Design Products for Various Reinforcing Conditions:
 - 1. Manufacturer: Hohmann & Barnard, Inc.
 - 2. Products:
 - a. Single-Wythe CMU: 220 Ladder Mesh.
 - b. Double-Wythe CMU: 240 Ladder-Twin-Mesh.
 - c. Single-Wythe CMU and Brick Veneer: 170-2X Truss Eye-Wire Reinforcement.

2.8 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars Product Quality Standard: ASTM A615 or ASTM A996, Grade 60.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler:

- 1. Product Quality Standard: ASTM D1056, Grade 2A1.
- 2. Description: Premolded filler strips formulated from neoprene; compressible up to 35 percent; of width and thickness indicated.

- B. Preformed Control Joint Gaskets:

- 1. Product Quality Standard: ASTM D2000, Designation M2AA-805.
- 2. Description: Formed from styrene-butadiene-rubber compound designed to fit standard sash block to maintain lateral stability in masonry wall; size and configuration as indicated.

- C. Bond Breaker Strips:

- 1. Product Quality Standard: ASTM D226, Type I.
- 2. Description: Asphalt-saturated, organic roofing felt (Number 15 asphalt felt).

- D. Reinforcing Bar Positioners:

- 1. Description: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142 inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
- 2. Acceptable Manufacturers and Products:
 - a. Dayton Superior Corp., Dur-O-Wal Div.; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

- E. Cavity Insulation: As specified in Division 07 Section "Thermal Insulation."

- F. Acoustical Isolation Joint Filler:

- 1. Description: Sheets composed of non-woven plastic mesh molded and shaped into an open weave configuration; 16 inches by 96 inches by 1-3/4 inch thick.
- 2. Basis of Design:
 - a. Manufacturer: Archovations.
 - b. Product: CavClear Masonry Mat.

2.10 MORTAR AND GROUT MIXES

- A. General: Mix cementitious materials in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency; do not hand mix.

1. Admixture Limitation: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, calcium chloride, or other admixtures, unless otherwise indicated.
2. Cementitious Limitation: Limit cementitious materials in mortar and grout to portland cement and lime.
3. Ingredient Measurement: Measure in a one cubic foot batching box before mixing for component materials not preblended, prepackaged or containerized.
4. Aggregate Moisture Content: Monitor moisture content of aggregates and exercise caution when mixing to avoid over or under-saturation of the mortar.

B. Mortar Mix:

1. Mix Quality Standard: ASTM C270, Proportion Specification for portland cement-lime mortars, Types as follows for applications stated unless another type is indicated:
 - a. Non-Reinforced Masonry: Type N.
 - b. Reinforced Masonry: Type S.
 - c. Other Applications: Type N where another type is not indicated.

C. Grout for Unit Masonry:

1. Product Quality Standard: ASTM C476.
2. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
3. Use fine grout in grout spaces less than 2 inches in horizontal dimension.
4. Use coarse grout in grout spaces 2 inches or more in least horizontal dimension.
5. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine substrates to which concrete unit masonry will be placed for compliance with requirements, installation tolerances and other conditions affecting performance.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance.

3.2 PREPARATION

- A. Substrate Cleaning: Remove construction debris, dust, dirt, mud, oil, and other materials on surfaces that would adversely affect or reduce bond of masonry and mortar.

3.3 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. TMS 602/ACI 530.1/ASCE 6, unless local building code has jurisdiction.
 2. Applicable portions of NCMA TEK's.
 3. Respective manufacturer's written installation instructions.

- B. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- C. Chases and Recesses: Build to accommodate items specified in this and other Sections.
- D. Openings: Leave for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- E. Cutting: Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.4 LAYING MASONRY WALLS

- A. General: Lay out walls in advance for accurate spacing of surface bond patterns, uniform joint thicknesses, accurate location of openings, movement-type joints, returns, and offsets. Avoid using less than half-size units at corners, jambs, and, where possible at other locations.
- B. Bond Pattern for Exposed Masonry:
 - 1. Exposed Masonry: Unless otherwise indicated, lay with all units in a wythe in running bond.
 - 2. Concealed Masonry: Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inch lap.
 - 3. Corners: Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 8 inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop Work by racking back units in each course from those in course below; do not tooth. When resuming Work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar.
- D. Built-in Work:
 - 1. As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
 - 2. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
 - 3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- E. Concrete Masonry Cores Under Loads: Fill cores in hollow concrete masonry units with grout 24 in under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- F. Exposed Concrete Masonry: Where concrete masonry will be exposed, or clear sealed, it shall be free of damage and defects when viewed from 60 inches away by the Architect. Keep faces to be left exposed free of mortar and grout.

3.5 MORTAR BEDDING AND JOINTING

- A. Mortar Joint Thickness: Minimum 3/8 inches wide for head and bed joints.

- B. Hollow Concrete Masonry Units: Lay as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- C. Solid Concrete Masonry Units: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- D. Joint Tooling: Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
1. Make mortar joints straight, clean, and uniform in thickness. Tool joints to produce dense surface well bonded to edges.
 2. Joints which are not tight at time of tooling shall be raked out, pointed, and then tooled.
 3. Tool when mortar is partially set but still sufficiently plastic to bond.
 4. Use a tool which compacts mortar, pressing excess mortar out of joint rather than dragging it out.
 5. Tool vertical joint first.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inches on exterior side of walls, 1/2 inches elsewhere. Lap reinforcement a minimum of 6 in.
1. Space reinforcement not more than 16 inches on centers.
 2. Space reinforcement not more than 8 inches on centers in parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Installation Conditions:
1. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
 2. Provide continuity at wall intersections by using prefabricated T-shaped units.
 3. Provide continuity at corners by using prefabricated L-shaped units.
 4. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL JOINTS

- A. General: Install control joint materials as masonry progresses. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement. Maintain joints free and clear of mortar.
- B. Control Joints: Form in concrete masonry using one of following methods:
1. Install preformed control-joint gaskets designed to fit standard sash block.
 2. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
 3. At structural bond beams, provide dummy groove or raked joint. Do not extend control joints through bond beams.

- C. Control Joint Spacing: Locate 3/8 inch wide control joints as indicated but do not exceed 30 feet on centers.
- D. Horizontal, Pressure-Relieving Joints: Provide by leaving an air space of width required for installing sealant and backer rod specified in appropriate Division 07 Section, but not less than width indicated.

3.8 LINTELS

- A. Masonry Lintels: Provide lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.
 - 1. Provide precast concrete lintels made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars required to support loads indicated.
 - 2. Provide prefabricated or built-in-place masonry lintels. Use specially formed bond beam units with reinforcing bars placed and filled with coarse grout. Cure precast lintels before handling and installing.
- B. Minimum Bearing: Provide 8 in at each jamb, unless otherwise indicated.

3.9 REINFORCED MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
 - 1. Provide minimum bar lap splice not less than 48 bar diameters unless otherwise indicated.
 - 2. Provide corner bars of same size and spacing as horizontal bars unless otherwise indicated.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height unless otherwise required by local applicable code.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
 - 3. Limit height of vertical grout pours to not more than 60 inches.
 - 4. Fill with grout, vertical cells, bond beams, lintels and other structural members having reinforcement. Secure in place and inspect reinforcing before grouting. Keep mortar droppings out of grout space and puddle or vibrate grout in place.

5. Provide solid bearing under structural members at least 8 inches vertically and at least 16 inches horizontally. Bearing may be solid units, or hollow units with grout. Fill cells in units adjacent to openings.
6. Grout from inside face of masonry and prevent grout from staining masonry face. Protect projecting surfaces from droppings and clean immediately any grout which comes in contact with face of masonry.

3.10 TOLERANCES

A. Conspicuous Lines:

1. Vertical: For such conditions as external corners, door and window jambs, reveals, and expansion joints, maximum variation of one of following from plumb:
 - a. 1/4 inch in 20 feet.
 - b. 1/2 inch overall.
2. Horizontal: For such conditions as exposed lintels, sills, door and window heads, parapets, and reveals, maximum variation of one of following from level:
 - a. 1/4 inch in 20 feet.
 - b. 1/2 inch overall.

B. Exposed Head Joints:

1. Vertical Alignment: Maximum variation of one of following from plumb:
 - a. 1/4 inch in 10 feet.
 - b. 1/2 inch from plumb top to bottom of wall.
2. Thickness: Maximum variation from width indicated of plus or minus 1/8 inches; maximum variation from adjacent bed joint and head joint thicknesses 1/8 inch.

C. Exposed Bed Joints: Maximum variation from width indicated of plus or minus 1/8 in, with a maximum thickness limited to 1/2 inches; maximum variation from bed joint thickness of adjacent courses of 1/8 inch.

D. Flush Alignment: Maximum variation of 1/16 inches except due to warpage of masonry units with tolerances specified for warpage of units.

E. Stack Bond: For exposed head joints and bed joints, maximum variation from a straight line of 1/16 in from one masonry unit to next.

3.11 ADJUSTING

- A. Damaged Units: Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids and holes, except weeps and vents, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

3.12 PROTECTION

- A. Protection of Work: When installed at building interiors, provide protection of lower 96 inch portion of concrete masonry in form of rigid panels to prevent damage and to resist staining.
- B. Cleaning: During cleaning operations, protect surrounding areas, landscaping, adjacent surfaces, and vehicles from contact with cleaning products.
 - 1. Clean surfaces prior to installation of windows and doors.
 - 2. Avoid drifting of spray caused by wind.

3.13 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as Work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Miscellaneous steel fabrications and accessories to complete installation.

1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36.
- C. Steel Tubing: ASTM A500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Cast Iron: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.

2.2 FASTENERS AND ANCHORS

- A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- B. Post-Installed Anchors:
1. Type: Torque-controlled expansion anchors.
 2. Material: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, and compatible with topcoat.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28 day compressive strength of 3000 pounds per square inch.

2.4 FABRICATION

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6 inch embedment and 2 inch

hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- B. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.3 ADJUSTING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0 mil dry film thickness.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY SPECIFICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Non-structural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Roof-mounted curbs.
- F. Roofing Nailers.
- G. Roofing cant strips.
- H. Preservative-treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Communications and electrical room mounting boards.
- K. Concealed wood blocking, Nailers, and supports.
- L. Miscellaneous wood Nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 033000 - Cast-in-Place Concrete: Setting anchors in concrete.
- C. Section 051200 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- D. Section 055000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- E. Section 061733 - Wood I-Joists.
- F. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.
- G. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2018.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023C.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.
- F. PS 1 - Structural Plywood; 2019.
- G. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2018.
- H. PS 20 - American Softwood Lumber Standard; 2020.
- I. WWPA G-5 - Western Lumber Grading Rules; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Structural Composite Lumber: Submit the manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old-growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Stud Framing (2 by 2 through 2 by 6):
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, as indicated on structural drawings.

2.03 TIMBERS FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry (23 percent maximum).
- C. Beams and Posts 5 inches and over in thickness:
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.

2.04 STRUCTURAL COMPOSITE LUMBER

- A. At the Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers.
- B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.05 CONSTRUCTION PANELS

- A. Roof Sheathing: Any PS 2 type rated Structural I Sheathing.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: 1/2 PERF CAT.
- B. Wall Sheathing: Any PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 15/32 PERF CAT.
 - 5. Edge Profile: Square edge.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.06 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Die-Stamped Connectors: Hot-dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative-treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Joist Hangers: Hot-dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative-treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed-cell plastic foam from continuous rolls.

2.07 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying the level and type of treatment in accordance with AWWA standards.
- B. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
 - b. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on-site as accessory components, including shims, bracing, and blocking.
- C. Where treated wood is used on the interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in an unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads and provide temporary bracing sufficient to maintain the structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members at full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA (WFCM) Wood Frame Construction Manual.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fire blocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless the item can be securely fastened to two or more studs or another method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above the ceiling unless another method of support is explicitly indicated.
- E. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf support.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Wall paneling and trim.
 - 8. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners

by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimensions perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. Nail panels to framing; staples are not permitted.
- B. Wall Sheathing: Secure with long dimensions perpendicular to wall studs, with ends over firm bearings and staggered, using nails.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at a maximum of 24 inches on center on all edges and into studs in the field of board.
 - 1. On fire-rated walls, install a board over the wallboard indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with the long edge of the board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size and Location: As indicated on drawings.

3.07 TOLERANCES

- A. Framing Members: 1/4 inch from the true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

3.09 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on the project site.
 - 3. Do not burn scraps that have been pressure-treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 061733**WOOD I-JOISTS****PART 1 GENERAL****1.1 Scope**

This work includes the complete furnishings and installation of all TJI® joists as shown on the drawings herein specified and necessary to complete the work.

1.2 Code Approvals

These products shall be designed and manufactured to the standards outlined in the ICC Evaluation Service, Inc. report ESR-1153.

1.3 Related Work Specified Elsewhere**A Carpentry and Millwork****1.4 Design****A Products**

Trus Joist® products shall be designed to fit the dimensions and loads indicated on the plans.

A Design Calculations

Not required.

1.5 Submittals**A Drawings**

Not required.

B Production

Fabrication and/or cutting shall not proceed until the architect and/or engineer have approved the submittal package.

2.0 PRODUCTS**2.1 Materials**

Flange members, web members, and adhesives shall conform to the provisions of the ICC ES ESR-1153.

2.2 Fabrication

TJI® joists shall be manufactured by Weyerhaeuser in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency.

2.3 Tolerances (dry material)

Depth: $\pm 1/16"$

Flange width: $\pm 1/16"$

2.4 Identification

Each of the joists shall be identified by a stamp indicating the joist series and ICC ES evaluation report number, manufacturer's name, plant number, and the independent inspection agency's logo.

2.5 Hardware

Not applicable.

3.0 EXECUTION

3.1 Installation

TJI® joists, if stored before installation, shall be stored in a vertical position and protected from the weather. They shall be handled with care so they are not damaged. TJI® joists are to be installed in accordance with the plans and any Weyerhaeuser drawings and installation suggestions. Temporary construction loads that cause stresses beyond design limits are not permitted. Safety bracing is to be provided by the installer to keep the TJI® joists straight and plumb as required and to assure adequate lateral support for the individual TJI® joists and the entire system until the sheathing material has been applied.

The contractor may give notification to the manufacturer before the installation of Trus Joist products to review and discuss product installation guidelines.

3.2 Performance Standards

Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5055.

3.3 Fire Rating/Sound Ratings

Fire and sound ratings are to be established in accordance with assemblies as detailed in ICC ES ESR-1153 or the *Directory of Listed Products*, published by Intertek Testing Services.

3.4 Warranty

The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building.

4.0 ALTERNATES AND/OR EQUALS**4.1 Modifications/Alternates:**

Due to the customized detailing and engineering characteristics of the roof and/or floor framing assembly, it is a requirement that TJI® joists be used in the base bid.

The specification is based on Trus Joist-engineered wood products. No alternatives, modifications, or substitutions are allowed unless the General Contractor and Sub-Contractors submit in writing such requests to the Project Engineer for approval, no later than two weeks before the bid. Alternate products must have a current ICC-ES code evaluation report with listed design properties equivalent to or greater than specified products. Substantiating calculations shall be submitted. All floor performance, fire endurance, holes, tapered cuts, and notching shall be justified for alternate. The contract shall reflect any price changes. The engineer of record shall be reimbursed for any review time.

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Unfaced fiberglass batt insulation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

2.2 UNFACED FIBERGLASS BATT INSULATION

- A. Product Quality Standard: ASTM C665, Type I.
- B. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder; formaldehyde free.
- C. Surface Burning Characteristics: According to ASTM E84.
1. Flame Spread: Class A, no greater than 25.
 2. Smoke Developed: No greater than 50.
- D. Combustion Characteristics: Pass according to ASTM E136.
- E. Thickness: As indicated on the Drawings.
- F. Acceptable Manufacturers and Products:
1. CertainTeed Corp.; CertaPro.
 2. Johns Manville; Unfaced Batts.
 3. Owens-Corning; Pink Next Gen Fiberglass Insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
1. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of the work.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Cleaning: Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- E. If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 072720
SHEET AIR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Synthetic sheet air barrier over sheathed wood studs and accessories indicated, specified, or required for installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each product indicated, specified, or required.
1. Include manufacturer's installation instructions.
 2. Include manufacturer's standard detail drawings for attachment, lapping, openings, penetrations, corners, and other conditions to be encountered.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

2.2 SHEET AIR BARRIERS

- A. Product Quality Standard: ASTM E 1677, Type I.
- B. Synthetic Sheet Air Barrier for Exterior Wall Cladding other than Stucco:
1. Description: Non-perforated, non-woven, polyethylene or polypropylene sheet, bonded under heat and pressure, without binders or fillers; with smooth surface.
 2. Minimum Physical Properties:
 - a. Water Penetration Resistance: Not less than 280 cm according to AATCC 127.
 - b. Moisture Vapor Transmission: Not less than 28 perms according to ASTM E 96, Method B.
 - c. Air Penetration Resistance: Not more than 0.001 cfm/sq ft at 1.57 psf according to ASTM E 2178.
 - d. Ultraviolet Light Degradation: No damage after 9 months of exposure.
 3. Basis of Design:
 - a. Manufacturer: DuPont.
 - b. Product: Tyvek CommericalWrap.
- C. Synthetic Sheet Air Barrier for Exterior Wall Stucco Cladding:
1. Description: Non-perforated, non-woven, polyethylene or polypropylene sheet, bonded under heat and pressure, without binders or fillers; with grooved surface pattern in

- vertical direction.
2. Minimum Physical Properties:
 - a. Water Penetration Resistance: Not less than 210 cm according to AATCC 127.
 - b. Moisture Vapor Transmission: Not less than 50 perms according to ASTM E 96, Method B.
 - c. Air Penetration Resistance: Not more than 0.004 cfm/sq ft at 1.57 psf according to ASTM E 2178.
 - d. Ultraviolet Light Degradation: No damage after 180 days of exposure.
 3. Basis of Design:
 - a. Manufacturer: DuPont.
 - b. Product: Tyvek StuccoWrap.

2.3 ACCESSORIES

A. Barrier Seaming Tape:

1. Description: Pressure sensitive, adhesive coated tape for sheet to sheet lap joints; temperature and ultraviolet light degradation resistant; provided by barrier manufacturer.
2. Basis of Design: DuPont; Tyvek Tape.

B. Barrier Flashing Tape:

1. Description: Barrier material laminated to adhesive coated rubberized asphalt or butyl for sheet to surrounding construction sealing; provided by barrier manufacturer.
2. Basis of Design: DuPont; FlexWrap and StraightFlash.

C. Mechanical Fasteners: Provided by barrier manufacturer:

1. Nails: Corrosion resistant, of type, size, and shank size and length as required by conditions to penetrate sheathing and into wood stud.
2. Caps: High-density polyethylene; ultraviolet light degradation resistant; not less than 2 in diameter.
3. Limitation: Staples are not permitted nor will be allowed.

D. Joint Sealant: Silicone construction sealant specified in applicable Section 07 92 00 - Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine substrate surfaces to which sheet air barriers will be placed for compliance with requirements and other conditions affecting performance.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting work within a particular area will be construed as acceptance.

3.2 PREPARATION

A. General Procedures: Provide clean, dust-free, and dry substrates according to manufacturer's

written instructions.

3.3 INSTALLATION

- A. Installation Performance Requirements: Ensure sheet air barrier isolates building interiors from air and water infiltration through exterior walls.
- B. Sheet Installation: Install sheets to form continuously sealed synthetic sheet air barrier over sheathing.
 - 1. Install prior to installation of windows and doors.
 - 2. Layout and arrange seams and laps so that they will not occur over sheathing joints or fasteners.
 - 3. Start installation at the bottom of a building corner, leaving 6 to 12 in of sheet extended beyond corner to overlap.
 - 4. Extend lower edge of bottom sheet down to bottom of ledge formed in foundation and seal with joint sealant.
 - 5. Accurately align horizontally; pull taut to eliminate fishmouths, wrinkles, buckles, and kinks; install in shingled manner to shed water without interception by exposed edges.
 - 6. Install overlapping upper sheet over underlying lower sheet lapping 6 in minimum at horizontal joints and ends; stagger end laps; lap 12 in minimum at inside and outside corners; lap flashing 6 in minimum. Seal seams with barrier seaming tape.
 - 7. Extend sheets over window and door openings.
 - 8. Seal joints and penetrations caused by pipes, conduits, electrical boxes, and similar items penetrating barrier with barrier flashing tape.
 - 9. Attach using mechanical fasteners at horizontal and vertical spacings recommended by barrier manufacturer.
 - 10. Repair punctures, tears, voids, damage, and deficiently lapped seams with barrier flashing tape extending 6 in minimum beyond damaged areas in all directions.
- C. Window and Door Openings: Cut sheet over openings according to manufacturers recommended pattern, wrap into opening, and seal head, jambs, and sill with barrier flashing tape in sequence recommended by manufacturer.

3.4 PROTECTION

- A. Procedures: Protect sheet air barriers from damage during installation and remainder of construction period according to manufacturer's instructions. Remove and replace sheet air barriers exposed to sunlight for more than number of days allowed by manufacturer.

END OF SECTION

SECTION 074213
FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Exposed-fastener lap-seam metal wall panels and accessories indicated, specified, or required to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each product indicated, specified, or required.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings: Detailed and dimensioned plans, elevations, large-scale details. Distinguish between shop- and field-assembled work.
1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
1. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.
- E. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company with not less than 5 years' experience in performing specified work similar in design, products, and extent indicated for this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required Work.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and

surface damage.

- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

- 2. Warranty Period: Two years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
 - b. Chalking in excess of a Number 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified on the Drawings to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

- 1. Berridge Manufacturing Company.
 - 2. Centria Architectural Systems.
 - 3. MBCI.
 - 4. Morin - A Kingspan Group Company.
 - 5. PAC-Clad - Petersen Aluminum Corporation.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the

following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
 2. Deflection Limits: For wind loads, no greater than $L/180$ of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cubic feet per minute per square foot when tested according to ASTM E283 at the following test-pressure difference:
1. Test-Pressure Difference: 1.57 foot pounds per square foot.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 foot pounds per square foot.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

2.3 EXPOSED – FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Metal Wall Panels: Formed with horizontal panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
 - a. Nominal Thickness: 0.022 inch (24 gauge).
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 36 inches.
 3. Panel Height: 1.5 inches.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653, G90 coating designation or ASTM A792, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless

otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1 inch thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and

- seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

A. Appearance of Finished Work:

1. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of range of approved submittal samples.
2. Noticeable variations in same piece are not acceptable.
3. Variations in appearance of other components are acceptable if they are within range of approved submittal samples and they are assembled or installed to minimize contrast as determined by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - a. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - b. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - 1) Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
 - c. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 - 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 3. At panel splices, nest panels with minimum 6 inch end lap, sealed with sealant and

fastened together by interlocking clamping plates.

- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ADJUSTING

- A. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075423
THERMOPLASTIC POLYOLEFIN MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fully adhered thermoplastic polyolefin membrane roofing.
2. Roof insulation.
3. Cover board.
4. Accessories indicated, specified, or required to complete installation.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each product.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work, including:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

- C. Samples for Verification: Sheet roofing, of color required.

D. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

- a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

- E. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications:

1. Experience: Company with not less than 5 years' experience in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required work.
2. Supervision: Maintain competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.

C. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Required Attendees:

- a. Owner.
 - b. Architect.
 - c. Contractor.
 - d. Owner's insurer if applicable.
 - e. Roofing Installer.
 - f. Roofing system manufacturer's technical representative.
 - g. Deck Installer.
 - h. Other installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
 - 2. Warranty Period: 20 years No Dollar Limit from date of Substantial Completion.
- B. Installer's Special Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."
 - 1. Carlisle SynTec Inc.
 - 2. GAF Materials Corp.
 - 3. Holcim Elevate.
 - 4. Johns Manville.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D3746 or ASTM D4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and

shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: SH.

2.3 THERMOPLASTIC POLYOLEFIN MEMBRANE ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D6878, flexible, heat weldable sheet composed of thermoplastic polyolefin polymer and ethylene propylene rubber with polyester weft inserted reinforcement.

1. Thickness: 60 mils, nominal.
2. Exposed Face Color: White.

2.4 RELATED ROOFING MATERIALS

- A. General: Related materials recommended by roofing system manufacturer for intended use and compatible with roofing.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2,
1. Felt or glass-fiber mat facer on both major surfaces.
 2. Compressive Strength: 20 pounds per square inch.
 3. Size: 48 inches square.
 4. Thickness: Not less than two layers.
 - a. Base Layer: 1-1/2 inches.
 - b. Upper Layer: As required to meet R-Value.
 5. R value: As indicated on the Drawings.

- C. Tapered Insulation: Factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Other Insulation Units: Preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 RELATED INSULATION MATERIALS

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer; one of the following:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

2.7 COVER BOARD

- A. Description: ASTM C1177, glass-mat, water-resistant gypsum substrate, 5/8 inch thick.
 - 1. Moisture Absorption Rate: 5 percent or less by weight according to ASTM C473.
 - 2. Surfaces Moisture Absorption: Nominal 1.0 grams according to ASTM C473.
- B. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.
 - 1. Manufacturer: Georgia-Pacific LLC.
 - 2. Product: DensDeck Prime StormX Roof Boards.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates to receive thermoplastic polyolefin membrane roofing and associated Work for compliance with requirements and other conditions affecting performance.
 - a. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - b. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation over wood decking.
 - 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
 - a. Install in two or more layers.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - 2. Adhere base layer of insulation to wood decks.
 - 3. Adhere upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

- 1) Trim insulation so that water flow is unrestricted.
- f. Fill gaps exceeding 1/4 inch with insulation.
- g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- h. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF COVER BOARDS

- A. Adhere cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 4. Loosely lay cover board over substrate.
 5. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 FULLY ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

SECTION 076200
SHEET METAL FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Parapet scuppers with conductor head.
2. Downspouts.
3. Miscellaneous flashings.
4. Related materials necessary to complete installation.

1.2 SUBMITTALS

A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Detailed and dimensioned plans, elevations, large-scale details of sheet metal flashing and trim. Distinguish between shop- and field-assembled work.

1. Include material, thickness, weight, and finish for each item and location in Project.
2. Include details for forming, including profiles, shapes, seams, and dimensions.
3. Include details for joining, supporting, securing, including layout and spacing of fasteners, clips, cleats, and other attachments.
4. Include details showing interface and relationship to adjacent materials.

C. Samples for Verification: 8 inches square sample for each type of exposed coil-coated, metallic-coated steel sheet.

D. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.3 QUALITY ASSURANCE

A. Quality Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Installer Qualifications:

1. Experience: Installer with not less than 5 years' experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects and with sufficient production capability, facilities, and personnel to produce required Work.
2. Supervision: Installer shall maintain a competent supervisor who is at Project site during times specified Work is in progress that is experienced in installing systems similar to type and scope required for Project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.

1.5 WARRANTY

- A. Manufacturer's Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
 - b. Chalking in excess of a Number 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- B. Installer's Special Warranty: Installer's warranty, signed by Installer, covering the Work of this Section, including all components of sheet metal flashing and trim within two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL FLASHING MATERIALS

- A. Coil-Coated Metallic-Coated Steel Sheet:
 - 1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
 - 2. Surface: Smooth, flat finish.
 - 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Color and Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation; structural quality, mill phosphatized for field painting, not less than 0.028 inches thick (24 gauge) nominal unless otherwise indicated.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with

release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D1970; stable after testing at 240 degrees F.
2. Low-Temperature Flexibility: ASTM D1970; passes after testing at minus 20 degrees F.

2.3 RELATED MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Suitable fasteners designed to withstand design loads.
 1. Material: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer.
 2. Finish: Match finish of exposed heads with material being fastened.
 3. Exposed Fasteners: Self-drilling screws, gasketed, with hex washer head.
 4. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated.
 1. Obtain field measurements for accurate fit before shop fabrication.
 2. Do not use graphite pencils to mark metal surfaces.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- D. Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- H. Fabricate inside and outside corners, intersections, and complex flashing conditions in shop with properly folded, constructed joints.
- I. Exposed edges of metal flashing shall be folded and hemmed.
- J. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- K. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8 offset of adjoining faces and of alignment of matching profiles.
 - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

2.5 PARAPET WALL SCUPPERS WITH CONDUCTOR HEAD

- A. Description:
 - 1. Parapet Scupper: 4 inch wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.
 - 2. Conductor Head: Box-like construction to direct water flow into downspout; with flanged back and stiffened top edge complete; with exterior flange trim and overflow opening in face.
- B. Fabrication Quality Standards: SMACNA Figure 1-27A.
- C. Material: Coil-coated metallic-coated steel sheet; base metal thickness of 0.028 inches (24 gauge).

2.6 DOWNSPOUTS

- A. Description: Round shape complete with formed elbows and offsets.
 - 1. Changes in Direction: Factory mitered, riveted and sealed with silicone sealant.
 - 2. Joints: Upper section fits into lower section.
- B. Fabrication Quality Standards:
 - 1. Downspout: SMACNA Figure 1-32A.
 - 2. Gutter to Downspout Transition: SMACNA Figure 1-33D.
 - 3. Hanger: SMACNA Figure 1-35D.
- C. Material: Coil-coated metallic-coated steel sheet; base metal thickness of 0.022 inches (26 gauge).

2.7 MISCELLANEOUS FLASHINGS

- A. Description: Formed-metal in section lengths not exceeding 12 feet of profiles indicated or required by conditions.
- B. Material: Coil-coated metallic-coated steel sheet; base metal thickness of 0.022 inches (26 gauge).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 METAL FLASHING INSTALLATION

- A. General: Secure sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
- B. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- C. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of sealant.
- D. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal. Space cleats not more than 12 inches apart. Secure each cleat with two fasteners. Bend tabs over fasteners.
- E. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inch for nails and not less than 3/4 inch for wood screws. Use stainless-steel fasteners unless otherwise recommended by material manufacturer.
- G. Seal joints with elastomeric or butyl sealant as required for watertight construction.
 - 1. At concealed sealant joints, embed hooked flanges of joint members not less than 1 inch into butyl sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 degrees F and 70 degrees F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. At exposed sealant joints, prepare joints and apply elastomeric sealants to comply with

requirements in Division 07 Section "Joint Sealants."

- H. Coordinate installation of reglets and counterflashings with installation of base flashings. Install reglets at height so that inserted counterflashings overlap 4 inches over top edge of base flashings. Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Fit counterflashings tightly to base flashings

3.3 CLEANING AND PROTECTION

- A. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 077113
SHEET METAL COPINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured sheet metal parapet wall copings.
2. Related materials necessary to complete installation.

1.2 SUBMITTALS

A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of copings, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:

1. Details for fastening, joining, supporting, and anchoring copings including fasteners, clips, cleats, and attachments to adjoining work.
2. Details for expansion and contraction.

C. Samples for Verification: 8 inches square sample for each type of exposed coil-coated, metallic-coated steel sheet.

D. Product Certificates: For each type of coping that is ANSI/SPRI/FM 4435/ES-1 tested.

E. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.3 WARRANTY

A. Manufacturer's Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace pre-manufactured metal copings that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
- b. Chalking in excess of a Number 8 rating when tested according to ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

B. Manufacturer's Special Wind Resistance Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace pre-manufactured metal copings that show evidence of failure due to winds up to and including 120 mph within 20 years from date of Substantial Completion.

1. Wind Resistance Warranty Period: 20 years from date of Substantial Completion.

- C. Special Manufacturer's Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace pre-manufactured metal copings and related work that does not remain watertight within 20 years from date of Substantial Completion
 - 1. Failures: Include, but are not limited to, following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.
 - 1. Manufacturer: PAC-Clad - Petersen Aluminum Corp.
 - 2. Product: PAC-Continuous Cleat Coping.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."
 - 1. Architectural Products Co.
 - 2. Cheney Flashing Company.
 - 3. Hickman, W. P. Company.
 - 4. Johns Manville
 - 5. Metal-Era, Inc.
 - 6. MM Systems Corporation.
 - 7. PAC-Clad - Petersen Aluminum Corp.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Manufacture and install copings to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Wind Design Standard: Manufacture and install copings that have tested according to ANSI/SPRI/FM 4435/ES-1 and is capable of resisting design wind pressures as indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

2.3 METAL FLASHING MATERIALS

A. Coil-Coated Metallic-Coated Steel Sheet:

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755.
2. Galvanized Thickness: 0.034 inches nominal (22 gauge).
3. Surface: Smooth, flat finish.
4. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Color: As selected by Architect from manufacturer's full range.
5. Concealed Color and Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation; structural quality, mill phosphatized for field painting, not less than 0.028 inches thick (24 gauge) nominal unless otherwise indicated.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

2.5 PARAPET WALL COPINGS

A. Copings: Sloping formed-metal coping cap in section lengths not exceeding 12 feet, with pre-fabricated, mitered corner units and end cap units, fabricated of coil-coated metallic-coated steel sheet.

B. Concealed Continuous Anchorage: Two-piece hold down cleats fabricated of galvanized sheet steel, one for inside face and one for outside face.

C. Joints: Splice plates of same shape, material and color as coping.

1. Concealed plate installed below copings.
2. Exposed plate installed on top of coping.
3. Pre-applied neoprene strips between plates.

2.6 RELATED MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads; of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing.
 - 1. Provide permanently elastic, non-sag, nontoxic, non-staining tape.
- D. Elastomeric Sealant: Silicone sealant as specified in Division 07 Section "Joint Sealants."

2.7 FINISH

- A. Finish Quality Standards: In addition to standards specified elsewhere, perform work according to following, unless otherwise specified:
 - 1. NAAMM's "Metal Finishes Manual for Architectural and Metal Products".
 - 2. AA's DAF-45 Designation Systems for Aluminum Finishes.
- B. Appearance of Finished Work:
 - 1. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of range of approved submittal samples.
 - 2. Noticeable variations in same piece are not acceptable.
 - 3. Variations in appearance of other components are acceptable if they are within range of approved submittal samples and they are assembled or installed to minimize contrast as determined by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates, areas, and conditions to verify conditions affecting performance of the Work.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. General: Install copings according to manufacturer's written instructions. Anchor securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete parapet wall copings.
 - 1. Install with provisions for thermal and structural movement.
 - 2. Torch cutting is not permitted.
- B. Install copings and accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks; and to result in watertight performance.

- C. Mechanically fasten concealed continuous anchorage cleats to wood blocking at top of parapet wall at manufacturer's recommended spacing.
- D. Provide for thermal expansion of copings. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.
- E. Anchor copings to resist uplift and outward forces according to performance requirements.
 - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's recommended spacing.

3.3 CLEANING

- A. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

3.4 ADJUSTING

- A. Replace copings that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Joint sealants, backing materials, and accessories necessary to complete their installation, including but not limited to:
1. Exterior Silicone Sealant – Class 50.
 2. Interior Silicone Sealant.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each joint sealant product and accessory indicated, specified, or required.
1. Include data to indicate performance criteria, limitations, substrate preparation, installation requirements, and curing requirements.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing full range of colors available for each product exposed to view.
- C. Samples for Verification: Samples for each kind and color of joint sealants in 1/2 inch wide joints formed between two 6 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- D. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications for Exterior Sealant Installations:
1. Experience: Installer with minimum of 5 years specialized experience in performing specified Work similar in design, material and extent to scope of Project, and with a record of successful in-service performance.
 2. Supervision: Installer shall maintain a competent supervisor who is on job site during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required.

1.4 FIELD CONDITIONS

- A. Ambient Conditions: Do not proceed with installation of joint sealants under following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

- B. Weather Conditions Limitation: Proceed with Work only when existing and forecasted weather conditions will permit installation according to manufacturer's instructions and warranty requirements.

1.5 WARRANTY

- A. Manufacturers Special Warranty for Silicone Sealants: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within 20 years' from date of Substantial Completion.
- B. Installers Special Warranty: Installer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within 2 years' from date of substantial completion.
- C. Exclusions: Includes, but not limited to, deterioration or failure of joint sealants from following:
 - 1. Movement of structure caused by structural settlement or errors attributable to design or construction resulting in stresses on sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."
- B. Single Source Responsibility: Furnish each product from single manufacturer.

2.2 EXTERIOR ELASTOMERIC SEALANTS

- A. Exterior Silicone Sealant – Class 50:
 - 1. Product Quality Standard: ASTM C920, Type S, Grade NS, Class 50.
 - 2. Description: Single component, non-sag, neutral cure, non-staining as determined by pre-construction stain testing, and non-bleeding, silicone sealant.
 - 3. Joint Movement Capability: Plus 50 percent, minus 50 percent.
 - 4. Primers: Product provided by sealant manufacturer if required by conditions.
 - 5. Acceptable Manufacturers and Products:
 - a. Dow Corning; 795 Silicone Building Sealant.
 - b. Momentive Performance Materials, GE Silicones; Silpruf SCS2000.
 - c. Pecora Corp.; 864NST.
 - d. Sika Corp., Construction Products Div.; SikaSil 295.
 - e. Tremco Commercial Sealants & Waterproofing; Spectrem 3.
 - 6. Color: As selected from manufacturer's standard colors.

2.3 INTERIOR ELASTOMERIC SEALANTS

A. Interior Silicone Sealant:

1. Product Quality Standard: ASTM C920, Type S, Grade NS, Class 25.
2. Description: Single component, non-sag, moisture curing, silicone sealant specially formulated with fungicide for use in sanitary non-porous applications.
3. Acceptable Manufacturers and Products:
 - a. Dow Corning; 786 Silicone Sealant.
 - b. Momentive Performance Materials, GE Silicones; Sanitary SCS1700.
 - c. Pecora Corp.; 898.
 - d. Sika Corp., Construction Products Div.; Sikasil GP or GN Plus.
 - e. Tremco Commercial Sealants & Waterproofing; Tremsil 200.
4. Color: As selected from manufacturer's standard colors.

2.4 JOINT SEALANT BACKING

A. Foam Backer Rods:

1. Product Quality Standard: ASTM C1330, Type C, Type O, Type B.
2. Description: As defined by ASTM C717, extruded polyethylene, polyurethane, or polyolefin in one of the following forms:
 - a. Type C: Closed cell structure.
 - b. Type O: Open cell structure.
 - c. Type B: Bicellular structure with surface skin.
3. Size: Diameter approximately 25 percent larger than joint width, unless otherwise directed by manufacturer.
4. Acceptable Manufacturers:
 - a. Adfast.
 - b. Alcot Plastics Ltd.
 - c. BASF Corporation.
 - d. Construction Foam Products; a Division of Nomaco, Inc.

- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 ACCESSORIES

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Non-porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine substrates to receive joint sealants and associated Work to which joint sealants will be applied for compliance with requirements and other conditions affecting performance.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

A. Cleaning of Joints: Clean out joints immediately before installing joint backings and sealants to comply with joint sealant manufacturer's written instructions and following requirements:

1. Remove foreign material that could interfere with adhesion of joint sealant, including, but not limited to, dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form-release agents from concrete.
4. Clean non-porous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer, or as indicated by prior experience, or as required by pre-construction compatibility and adhesion testing. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. ASTM C1193 for use of joint sealants as applicable to materials, applications, conditions indicated, and following profile configurations:
 - a. Fillet: Figure 5.
 - b. Bridge: Figure 6.

- c. Butt: Figure 8A (concave tooling), generally hour-glass shape with 2:1 width-to-depth ratio.
2. Substrate material allowed by sealant's ASTM C920 Use Classification.
 3. Respective manufacturer's written installation instructions.
- B. Joint Sealant Backings: Install kind required to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear backings.
 3. Install bond-breaker tape behind sealants where backings are not used between sealants and backs of joints.
- C. Joint Sealants: Install at same time as backings using proven techniques that comply with following:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 4. Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - a. Remove excess sealant from surfaces adjacent to joints.
 - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - c. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. In-Progress Cleaning: Remove excess sealant or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. General Requirements: Protect during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

END OF SECTION

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior custom hollow-metal doors and frames.
2. Accessories indicated, specified, or required to complete installation.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each type of product indicated, specified, or required.

1. Include manufacturer's written installation instructions.
2. Include construction details, material descriptions, core descriptions, and finishes.

- B. Shop Drawings: Scaled and dimensioned drawings of products to be incorporated into Work:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

- C. Samples for Verification:

1. Fabrication: Prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4 inch high wood blocking. Provide minimum 1/4 inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."
 - 1. Ceco Door Products; an Assa Abloy Group company.
 - 2. Curries Company; an Assa Abloy Group company.
 - 3. Pioneer Industries; an Assa Abloy Group company.
 - 4. Republic Doors and Frames; an Allegion company.
 - 5. Steelcraft; an Allegion company.
- B. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

2.2 EXTERIOR CUSTOM HOLLOW METAL DOORS AND FRAMES

- A. Commercial Doors and Frames: NAAMM-HMMA 861.
 - 1. Doors:
 - a. Thickness: 1-3/4 inches.
 - b. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60 or A60 coating.
 - c. Edge Construction: Continuously welded with no visible seam.
 - d. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - e. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - f. Core: Steel stiffened with mineral-fiber insulation.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, except 0.067 inch for openings exceeding 4 feet wide; with minimum G60 or A60 coating.
 - b. Construction: Full profile welded.
 - 3. Exposed Finish: Prime.

2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8 inch diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011; hot-dip galvanized in accordance with ASTM A153, Class B.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing minimum of 94 percent zinc dust by weight.

2.5 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 - B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- 2.6 STEEL FINISHES
- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates to receive hollow metal and associated Work for compliance with requirements and other conditions affecting performance.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with NAAMM-HMMA 840.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.

- b. Install frames with removable stops located on secure side of opening.
 - 2. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below. Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
- 3.4 INSTALLATION TOLERANCES
- A. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- 3.5 REPAIR
- A. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - B. Metallic Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 083323
OVERHEAD COILING DOOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.
2. Related materials necessary to complete installation.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads: As indicated on Drawings.

1.3 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

- C. Samples for Verification: For each exposed product and for each color and texture specified.

- D. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Sections.

1. Clopay Building Products.
2. Cornell Innovative Door Solutions.
3. Mahon Door Corporation.
4. McKeon Door Company.
5. Overhead Door Corporation.
6. Raynor.
7. Wayne-Dalton Corp.

2.1 SERVICE DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- B. Operation Cycles: Not less than 50,000.
- A. Air Infiltration at Exterior Door: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- B. Curtain R-Value at Exterior Door: 5.0 deg. F x h x sq. ft./Btu, minimum.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 2-5/8-inch inch center-to-center height.
1. Interior Facing: Metal.
 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- F. Hood: Match curtain material and finish.
1. Shape: Round.
 2. Mounting: Face of wall.
- G. Electric Door Operator:
1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
 2. Operator Location: Wall.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
 4. Motor Exposure: Interior.
 5. Emergency Manual Operation: Chain type.
 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
 7. Remote-Control Station: Interior.

8. Other Equipment: Audible and visual signals.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
 2. Insulation at Exterior Door: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from metal to match curtain slats and finish.
- C. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
 1. Provide jamb gasket to minimize noise of operating door and to prevent scratching of door finish from opening and closing.

2.3 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 1. Galvanized Steel: Nominal 0.028 inch thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653.
 2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.4 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Door: Weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door. Provide pull-down straps or pole hooks for doors more than 84 inches high.

2.6 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.7 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Electric Motors:
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.

3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- E. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
- F. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop;" full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- G. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- 2.8 FINISHES
- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
1. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 083613
OVERHEAD SECTIONAL DOOR

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Electrically operated overhead sectional door.

1.2 SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
1. Include plans, elevations, sections, and mounting details.
 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Sample Warranties: For special warranties.
- E. Maintenance Data: For sectional door to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional door that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.

2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional door shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Door: Capable of withstanding the design wind loads.
 1. Design Wind Load: As indicated on Drawings.
 2. Testing: According to ASTM E 330.
 3. Deflection Limits: Design sectional door to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

2.2 DOOR ASSEMBLY

- A. Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. Track Configuration: Standard-lift track.
- E. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- F. Roller-Tire Material: Manufacturer's standard.
- G. Counterbalance Type: Torsion spring.
- H. Electric Door Operator:
 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 2. Operator Type: Manufacturer's standard for door requirements.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.

4. Motor Exposure: Interior, clean, and dry.
5. Obstruction-Detection Device: Automatic electric sensor edge on bottom section.
 - a. Sensor Edge Bulb Color: Black.
6. Control Station: Interior-side mounted.

I. Door Finish:

1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's full range.
2. Finish of Interior Facing Material: Finish as selected by Architect from manufacturer's full range.

2.3 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 ALUMINUM DOOR SECTIONS

- A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4 inch minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.
1. Aluminum: ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch for door section 1-3/4 inches deep, and as required to comply with requirements.
 2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading.
 3. Provide reinforcement for hardware attachment.
- B. Glazed Panels: Manufacturer's standard, aluminum-framed section with glazing sealed with glazing tape and **aluminum** glazing bead. Glazing as follows:
1. Insulating Glass Units: Manufacturers' standard unit with tempered glass lites complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
1. Galvanized Steel: ASTM A 653, minimum G60 zinc coating.
 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jams when door unit is closed.
 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of door. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

- a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
 - b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.6 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079 inch nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for door more than 16 feet wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3 inch diameter roller tires for 3 inch wide track and 2 inch diameter roller tires for 2 inch wide track.

2.7 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

2.8 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
- 1. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.

- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics: As indicated on Drawings.
 - 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - 5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.9 ALUMINUM FINISHES

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates to receive overhead sectional door and associated work for compliance with requirements and other conditions affecting performance.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. Install sectional door and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional door, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Door: Install according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that door operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

- C. Adjust door and seals to provide weather-resistant fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional door.

END OF SECTION

SECTION 088000
GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Glazing for the following applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Exterior storefront.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product; 12 inches square.

1.3 QUALITY ASSURANCE

- A. Glazing Standards: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.4 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated glass manufacturer agrees to replace coated glass units that deteriorate within 10 years from date of Substantial Completion.
1. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions.
 2. Defects include peeling, cracking, and other indications of deterioration in coating.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating glass manufacturer agrees to replace insulatingglass units that deteriorate within 10 years from date of Substantial Completion.
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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

1. Vision Glass:

- a. Type: 1 inch thick insulating glass unit.
- b. Composition:
 - 1) Outside Lite: 1/4 inch thick, clear, heat strengthened glass with Low E coating on the #2 face.
 - 2) Airspace: 1/2 inch thick with black aluminum spacers.
 - 3) Inside Lite: 1/4 inch thick, clear, heat strengthened glass.

2.2 GLASS PRODUCTS

- A. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

- B. Low-E-Coated Vision Glass: ASTM C1376.

2.3 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190, and complying with other requirements specified.
 1. Sealing System: Dual seal with manufacturer's standard primary and secondary sealants of polyisobutylene and silicone.
 2. Spacer: Standard aluminum black spacers.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.

2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 1. Neoprene complying with ASTM C864.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: 100 percent silicone.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 1. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of the work.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without

developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 ADJUSTING

- A. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

3.5 PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect exterior glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 088300
MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Annealed monolithic glass mirrors and accessories indicated, specified, or required for installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product.
 - 1. Silvered mirrored glass. Include description of materials and process used to produce mirrored glass that indicates source of glass, glass coating components, edge sealer, and quality-control provisions.
 - 2. Mirror mastic.
 - 3. Mirror hardware.
- B. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing specified work similar in design, material and extent to scope of Project, and with a record of successful in-service performance.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.6 WARRANTY

- A. Manufacturers Special Warranty: Furnish warranty for a period of 5 years from date of substantial completion agreeing to repair or replace defects, faulty work and failures, including deterioration, signed by an authorized representative of manufacturer.
- B. Deterioration: Includes, but is not limited to, discoloration, black spots, and clouding of the silver film.
- C. Exclusions: Includes defects that are attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

- A. General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Glazing Quality, clear.

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

2.3 MIRROR HARDWARE

- A. Top and Bottom J-Channels: Type 304 stainless steel extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.05 inch.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.3075 inch.
 - 3. Finish: No. 4 satin.
- B. Fasteners: Stainless steel flat head machine screws.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

- A. Mirror Edge Treatment:
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Conditions:
 - 1. Examine substrates to which mirrors will be applied for compliance with requirements and other conditions affecting performance.

2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- B. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 1. Top and Bottom J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch between back of mirrors and mounting surface.

3.4 PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.

END OF SECTION

SECTION 092423
PORTLAND CEMENT STUCCO

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Portland cement stucco, elastomeric finish coat, and accessories indicated, specified, or required for installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required; including:
1. Characteristics and limitations of base coat and finish coat materials.
 2. Manufacturer's installation instructions.
- B. Samples for Verification: 12 inch square sample prepared on rigid backing for each type of factory-prepared finish coat indicated.

1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Manufacturer with 10 years continuous documented experience in design and manufacture of cement stucco of type and scope required for project.
- B. Applicator Qualifications:
1. Experience: Company experienced with not less than 5 years' experience in performing specified work similar in design, products, and extent to scope of this Project; with:
 - a. A record of successful in-service performance.
 - b. Sufficient production capability, facilities, and trained and skilled personnel.
 2. Supervision: Maintain a competent supervisor who is at Project during times specified work is in progress, and, who is experienced in installing work similar in design, products, and extent to scope of this Project.
- C. Field Samples: Before beginning work of this Section, make as many field samples as required to verify selections made under submittals. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing.
1. Build field samples approximately 48 inches square.
 2. Locate facing south.
 3. Use same workers, including supervisors, which will perform work on Project.
 4. Install products and materials according to specified requirements.
 5. Work on field samples shall be representative of those to be expected for work.
 6. Finish various components to show maximum variation that will exist in work.
 7. Obtain Architect's approval before starting work.
 8. Protect approved field samples from elements with weather resistant covering.
 9. Maintain field samples during construction in an undisturbed condition as a standard for judging completed Work.
 10. Do not demolish, alter, or remove field samples until acceptable to Owner and Architect.
 11. When directed, demolish and remove field samples from Project.

- D. Pre-Installation Conference: Before beginning Work of this Section, conduct conference at site to comply with requirements of Division 01 Sections.
1. Required Attendees:
 - a. Owner.
 - b. Architect.
 - c. Contractor, including superintendent.
 - d. Plaster Applicator, including supervisor.
 - e. Flashing installer, including supervisor.
 - f. Cold-formed steel stud framing installer, including supervisor.
 - g. Sheathing installer, including supervisor.
 - h. Manufacturer's technical representative.
 - i. Owner's testing agency.
 2. Minimum Agenda: Installer shall demonstrate understanding of Work required by reviewing and discussing procedures for, but not limited to, following:
 - a. Tour representative areas of required Work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of installation and other preparatory Work performed by other installers.
 - b. Review Contract Document requirements.
 - c. Review approved submittals.
 - d. Review installation procedures, including, but not limited to:
 - 1) Handling, storing and protecting products and materials.
 - 2) Evaluation of substrates on which stucco will be installed.
 - 3) Fabrication and placement of flashings.
 - 4) Preparation and mixing of stucco.
 - 5) Laying masonry units.
 - 6) Anchoring and attaching metal lath.
 - 7) Protecting installed stucco, including stain prevention.
 - e. Review required inspection, testing, certifying, and material usage accounting procedures.
 - f. Review forecasted weather conditions and procedures for coping with unfavorable conditions.
 3. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.

1.4 DELIVERY AND STORAGE

- A. Delivery: Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. Storage: Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature recommended by manufacturer. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.5 FIELD CONDITIONS

- A. Cold Weather Application Procedures: Do not apply stucco when substrate or ambient air temperature is less than 50 degrees F unless sand and mixing water are heated to 70 degrees F and temporary protection is provided to keep minimum 50 degrees F in stuccoed areas for 24

hours.

- B. Protection: Protect stucco from uneven and excessive evaporation during hot, dry weather.

1.6 WARRANTY

- A. Manufacturers Special Warranty: Furnish repair and replacement warranty for 10 years from date of substantial completion agreeing to repair or replace cement stucco finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

1. Manufacturer: Dryvit.
2. Series: Commercial Cement Plaster.
3. Option: CCP4.

2.2 WEATHER RESISTIVE BARRIER

- A. Barrier:

1. Description: Flexible, polymer-based, non-cementitious barrier coating.
2. Basis of Design:
 - a. Manufacturer: Dryvit.
 - b. Product: Backstop.

2.3 LATH AND TRIM ACCESSORIES

- A. Metal Lath:

1. Product Quality Standard: ASTM C 847.
2. Description: Expanded steel, diamond mesh lath, 3.4 lb/sq yd, self-furring.
3. Material Quality Standard: ASTM A 653, G90, hot-dip galvanized zinc coating.

- B. Tie Wire: 0.04 inch diameter (18 gage) galvanized and annealed low-carbon steel compliance with ASTM A 641 with Class I coating.

- C. Casing Beads:

1. Product Description: Square edge, expanded metal flange; perforated with minimum 1/4 in diameter holes at 12 inches on centers when used at bottom of stucco, non-perforated elsewhere; size required for stucco thickness.
2. Material Quality Standard: ASTM A 653, G60, hot-dip galvanized zinc coating.
3. Basis of Design: AMICO (Alabama Metal Industries Corp.); X-66 Casing Bead.

- D. Control Joints:

1. Product Description: Back-to-back J-shape that permits positive locking with stucco,

- expanded metal flange; size required for stucco thickness.
- 2. Material Quality Standard: ASTM B A 653, G60, hot-dip galvanized zinc coating.
- 3. Basis of Design: AMICO (Alabama Metal Industries Corp.); Griplock J Control Joint (#XJ15 Joint).

E. Outside Corner Reinforcement:

- 1. Product Description: Small nose corner beads, expanded metal flanges, with continuous stiffening ribs.
- 2. Material Quality Standard: ASTM A 653, G60, hot-dip galvanized zinc coating.
- 3. Basis of Design: AMICO (Alabama Metal Industries Corp.); X2 Cornerbead.

F. Inside Corner Reinforcement:

- 1. Product Description: Strips of galvanized expanded metal lath, minimum 3 in wide flanges, folded to 105 degrees, with smooth edges.
- 2. Material Quality Standard: ASTM A 653, G60, hot-dip galvanized zinc coating.
- 3. Basis of Design: AMICO (Alabama Metal Industries Corp.); Cornalath.

G. Strip Lath Reinforcement:

- 1. Product Description: Strips of expanded metal lath, 4 in to 6 in wide, with smooth edges.
- 2. Material Quality Standard: ASTM A 653, G60, hot-dip galvanized zinc coating.
- 3. Basis of Design: AMICO (Alabama Metal Industries Corp.); Striplath.

2.4 MISCELLANEOUS MATERIALS

A. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation (EPS): Comply with ASTM C 578, Type I, and the following:

- 1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than six weeks.
- 2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, according to ASTM E 84.
- 3. Foam Build-Outs: Provide with profiles and dimensions indicated on Drawings.

B. Sealant: Exterior non-sag silicone sealant specified in Division 07 Section "Joint Sealants."

2.5 PLASTER BASE

A. Plaster Base: Fiber reinforced, 100 percent acrylic based product which is field mixed with water

1. Basis of Design:

- a. Manufacturer: Dryvit.
- b. Product: Genesis.

B. Reinforcing Mesh: Balanced, open-weave, glass fiber fabric treated for compatibility with plaster base materials.

C. Water: Clean, fresh, potable water, free of mineral or organic matter which can affect based coat, field added.

2.6 PRIMER AND FINISH COAT

A. Primer:

1. Description: Water-based, pigmented acrylic primer for application over the cured plaster base to improve adhesion and provide a more uniform appearance of the finish.
2. Basis of Design:
 - a. Manufacturer: Dryvit.
 - b. Product: Color Prime.

B. Finish Coat:

1. Description: Water-based, acrylic coating with integral color and texture, with a minimum perm rating of 10 perms.
2. Basis of Design:
 - a. Manufacturer: Dryvit.
 - b. Product: Standard DPR.
 - c. Color: As selected from manufacturer's standard colors.

2.7 MIXING

A. General: Mix according to manufacturer's written instructions.

B. Plaster Base:

1. Mix materials dry to uniform color and consistency before adding water, then mix with water.
2. Mix only as much as can be used prior to initial set.
3. Do not retemper or use partially set mixes.
4. Do not use frozen, caked or lumpy materials.
5. Protect mixtures from frost, contamination, and evaporation.

C. Finish Coat:

1. Mix until a uniform workable consistency is attained.
2. A small amount of water may be added to adjust workability.
3. Use no additives such as rapid binders, antifreeze, or accelerators.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine substrates to receive cement stucco and associated work for compliance with requirements and other conditions affecting performance.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 APPLICATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform work according to following, unless otherwise specified:
1. ASTM C1063 for lathing.
 2. ASTM C926 for stucco.
 3. Applicable ICC-ES Evaluation Report.
 4. Respective manufacturer's written installation instructions.

3.3 INSTALLING WEATHER RESISTIVE BARRIER

- A. Install components in proper sequence to produce a continuous and uniform barrier.

3.4 INSTALLING TRIM ACCESSORIES

A. General Provisions:

1. Install at locations indicated according to installation quality standards in longest lengths possible to minimize quantity of butt joints. Avoid butt joints and splices within 24 inches of corners and intersections.
2. Attach securely according to following to hold accessories in place and alignment; secure at ends and not more than 12 inches on centers.
 - a. Screw fasteners at Z-shaped furring strips.
 - b. Tie wire when nested with metal lath.
3. Install so finished stucco surfaces will be true to line, level, plumb, square, curved or as otherwise required, without variation in thickness in area bounded by trim accessories.
4. Set vertical trim accessories plumb and horizontal trim accessories level.
5. Miter or cope to form true, tight, aligned, and neat corners and intersections seated with sealant and in alignment.
6. Remove cementitious materials from inside control joints and expansion joints before material set.

- B. Priority: Set vertical control joints and expansion joints continuous from top to bottom, cutting and coping horizontal joints to vertical joints.

C. Casing Beads:

1. Install continuous at openings, edges, other through wall penetrations, and terminations of stucco.
2. Use perforated beads at bottom of stucco areas and non-perforated at sides and top.

D. Control Joints: Install at locations approved by Architect for visual effect as follows:

1. As required to delineate work into areas (panels) of 144 square feet maximum.
2. At distances between control joints of not greater than 18 feet on centers.
3. As required to delineate work into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind stucco.
5. Where work areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

- E. Outside Corners: Install continuous outside corner reinforcement.

- F. Inside Corners: Install continuous inside corner reinforcement.
- G. Openings Through Lath: Secure strip lath reinforcement diagonally at corners of lathed openings.
- H. Sealant: Before installing metal lath, apply silicone sealant at corners, intersections, joints, and splices.

3.5 ATTACHING LATH

A. General Requirements:

1. Install multiple sheets, with dimples facing substrate, to form continuous plane over substrates. Ensure lath is properly held in front of substrate (depth of dimples) so that stucco will key through and surround lath, and drainage space will be created between scratch coat and substrate.
2. Begin at bottom of wall and install with long dimension at horizontal and stagger vertical end laps.
3. Do not extend metal lath behind control joints and expansion joints.
4. Lap lath 2 inches over trim accessory flanges.

3.6 APPLYING PLASTER BASE

A. General Provisions:

1. Apply by hand or by pneumatic wet gun application method.
2. Establish and follow an application pattern that produces an even drying surface of uniform thickness.
3. Avoid applying cementitious materials that are frozen, caked, lumpy, dirty, or contaminated by foreign materials.
4. Avoid applying cementitious materials to frozen substrates.
5. Avoid using excessive water.
6. Make internal corners and angles square; finish external corners flush with corner beads, square and true with stucco faces.

B. Applying First Coat of Plaster Base:

1. Apply with sufficient material and pressure to form keys into and embed metal lath to uniform thickness of 3/8 to 1/2 inch.
2. Embed reinforcing mesh in wet coating.
3. Allow to moist cure for not less than 48 hours before applying brown coat.

C. Applying Second Coat of Plaster Base:

1. Apply as soon as first coat is sufficiently rigid and capable of supporting second coat without damaging continuity of scratch coat or keying to metal lath.
2. Dampen first coat with water immediately before applying second coat.
3. Apply to uniformly cover dampened first coat with sufficient material and pressure to ensure tight, uniform bond to uniform thickness.
4. Bring surface to true, even plane.
5. Fill surface defects with stucco.
6. Uniformly float surface without variation more than 1/8 inch in any direction as measured by 10 foot straightedge.
7. Final thickness shall be not less than 1/2 inch nor more than 7/8 inch.
8. Allow to cure for not less than 7 days before applying finish coat.

9. Moist cure after stucco has set by lightly fogging for at least 48 hours. Fog as frequently as required during 48 hours to prevent loss of moisture. Avoid eroding stucco surface with excess moisture. If relative humidity exceeds 75 percent, frequency of moist curing can be diminished.

3.7 APPLYING FINISH COAT

A. Applying Primer:

1. Apply primer over base coat with brush, roller, or proper spray equipment in a continuous coat.
2. Allow to dry before applying finish coat.

B. Applying Finish Coat:

1. Apply to primed brown coat when dry.
2. Apply by spraying or troweling with a stainless steel trowel, depending on the finish specified.
3. Apply finish coat in a continuous application, always working to a wet edge, and work to finish that matches approved submittals.
4. Avoid application in direct sunlight.
5. Apply in a continuous application, and work a wet edge towards the unfinished wall area. Work to an architectural break in the wall before stopping to avoid cold joints.
6. Do not install separate batches of finish side-by-side.
7. Do not apply finish into or over joints or accessories.
8. Do not apply finish over irregular or unprepared surfaces, or surfaces.

3.8 ADJUSTING

- A. Patching: Cut, patch, repair, and point-up stucco as necessary to accommodate other work. Point-up finish stucco surfaces around items that are built into or penetrate stucco surfaces.
- B. Imperfections: Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing, check cracking, dry outs, efflorescence, sweat outs, excessive pinholes, and similar imperfections and where bond to substrate has failed.

END OF SECTION

SECTION 092900
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Related materials necessary to complete installation.

1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C11 for definitions of terms not defined in this Section or in other referenced quality standards.
- B. Damage: Stored or installed materials are classified as defective and nonconforming Work according to following:
 1. Wet or damp, or have been at any time.
 2. Exhibit evidence of active or dormant mold or mildew.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product indicated, specified or required.

1.4 FIELD CONDITIONS

- A. Environmental Conditions: Comply with ASTM C840 requirements or respective wallboard manufacturers written recommendations, whichever are more stringent.
- B. Do not install wallboards until installation areas are enclosed.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products and assemblies specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and does not change intent of Contract Documents as judged by Architect.
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

2.2 INTERIOR GYPSUM WALLBOARDS

- A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints and to correspond to support system indicated.
- B. Typical Paper-Faced Type X Gypsum Board:
 - 1. Material Quality Standard: ASTM C1396, Type X.
 - 2. Description: Noncombustible gypsum core with paper surfacing on face, back and long edges.
 - 3. Thickness: 5/8 inch.
 - 4. Long Edges: Tapered.
 - 5. Acceptable Manufacturers and Products:
 - a. CertainTeed Corp.; ProRoc Type X Gypsum Board.
 - b. G-P Gypsum Corp.; ToughRock Fireguard Gypsum Board X.
 - c. National Gypsum Co.; Gold Bond Brand Fire-Shield X Gypsum Board.
 - d. USG Corp.; Sheetrock Mold-Tough Firecode X Core.

2.3 TRIM ACCESSORIES

- A. Typical Drywall Trim Accessories:
 - 1. Material Quality Standard: ASTM C1047.
 - 2. Description: Trim profile fabricated of steel sheet with ASTM A653, minimum G40 hot-dip galvanized coating; of size suitable for wallboard thickness; with recessed, perforated flange formed to receive joint compound.
 - 3. Trim Products:
 - a. Cornerbead:
 - 1) Purpose: For protecting outside (external) corners.
 - 2) Basis of Design: USG Corp.; Dur-A-Bead Corner Bead, 103.
 - b. LC-Bead (J-Bead):
 - 1) Purpose: For protecting exposed edges of wallboard where back flange can be used.
 - 2) Basis of Design: USG Corp.; J-Trim, 200-A.
 - c. L-Bead:
 - 1) Purpose: For protecting exposed edges of wallboard where back flange cannot be used.
 - 2) Basis of Design: USG Corp.; L-Trim, 200-B.
 - d. J-Stop:
 - 1) Purpose: For protecting edges of wallboard that does not require finishing.
 - 2) Basis of Design: USG Corp.; J-Stop, 402.
 - e. Control Joint:
 - 1) Description: One-piece trim formed with V-shaped slot, with removable strip

- covering slot opening.
- 2) Purpose: For conditions requiring expansion and contraction stresses of large areas of wallboard to be relieved.
- 3) Basis of Design: USG Corp.; Control Joint, 093.

f. Other Trim or Special Shapes: Product as required by condition.

4. Acceptable Manufacturers:

- a. ClarkDietrich Building Systems.
- b. Fry Reglet Architectural Metals.
- c. Marino Ware.
- d. Niles Building Products Co.
- e. Superior Metal Trim.
- f. USG Corp.

2.4 FASTENERS

A. Gypsum Wallboard Nails:

- 1. Gypsum Board: ASTM C514, annular ring drywall nail; 12-1/2 gage, 19/64 inch diameter nail head, medium diamond point; length as required by conditions, but not less than 1-3/8 inches.
- 2. Cementitious Backer Units: Roofing nails; 11 gage, 7/16 inch diameter nail head; length as required by conditions, but not less than 1-3/8 inches.

B. Other Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by USG's "The Gypsum Construction Handbook" for conditions encountered.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

- 1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 2. Proceed only when unsatisfactory conditions have been corrected.
- 3. Starting work within a particular area will be construed as acceptance of conditions.

3.2 PREPARATION

A. Cleaning: Ensure ceiling and wall cavities are dry, clean and free of construction debris.

3.3 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform gypsum board assemblies work according to following, unless otherwise specified in this Section:

- 1. Respective manufacturer's installation written instructions.
- 2. GA 216 for application of gypsum board.
- 3. ASTM C 840 for installation of gypsum board.

B. Penetrations and Openings: Construct within gypsum board assemblies work as required to

properly form penetration or opening to receive firestopping materials specified in Division 07 Section "Penetration Firestopping".

- C. Control Joints: Form stress relieving joints, spaced not more than 24 feet in either direction for uninterrupted straight planes of ceilings, walls and partitions, to eliminate cracking of gypsum board assemblies, or finish, according to following:
1. Where ceiling, wall or partition framing changes direction within same plane.
 2. Where wallboard of ceilings, walls or partitions abutting inside face of exterior walls.
 3. Where wallboard of walls and partitions of differing fire ratings abut or align in same plane.
 4. Where wings of L, U, or T shaped ceiling configurations are joined.
 5. Less than ceiling height door frames and windows extending from both corners to ceiling.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: Fasten trim accessories continuously according to accessory manufacturer's instructions using fasteners; installation by clinch-on tool and staples not permitted.
- B. Typical Trim Accessories:
1. Corner Beads: Install trim at external corners; use fasteners at each flange at 9 inches on centers, opposite each other.
 2. Edge Trim: Install trim where wallboards abut dissimilar material, and where edge of wallboards would otherwise be exposed; use fasteners screws at flange at 9 inches on centers.
 - a. LC-Bead (J-Bead): Install trim at exposed conditions where back flange can be attached to framing or supporting substrate before wallboard installation.
 - b. L-Bead: Install trim at exposed conditions where trim can only be installed after wallboard installation.
 - c. J-Stop: Install trim at concealed conditions where trim can only be installed after wallboard installation.
 3. Control Joints: Install trim at appropriate locations, ensuring wallboard is not continuous over joint; use fasteners at each flange at 6 inches on centers.
- C. Accent Trim Accessories: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use fasteners at each flange at 9 inches on centers.
- D. Trim Accessories at Exterior Windows: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use fasteners at each flange at 9 inches on centers.

3.5 INSTALLING WALLBOARDS

- A. General Requirements:
1. Install type of wallboard at location indicated by wallboard schedule at end of this Section.
 2. Avoid installing imperfect, damaged, wet, or damp wallboards.
 3. Install ceiling wallboards before wall and partition wallboards.
 4. Install wallboards with finishable face side out.
 5. Butt wallboards together for a light contact at edges and ends with not more than 1/16 in of open space between panels.
 6. Avoid forcing wallboards into place.
 7. Avoid placing tapered edges against cut edges or ends.

B. Single-Layer Board Assemblies:

1. At typical conditions, install wallboard vertically (long dimension parallel to stud framing), to minimize short end-to-short end joints unless otherwise indicated or required by assembly fire test reports.
2. At interior of stairwells and other high walls, install wallboards horizontally, unless otherwise indicated or required by assembly fire test reports. Stagger abutting end joints not less than one framing member in alternate courses of wallboards.

C. Ceiling Applications:

1. Apply wallboard at right angles to main beams of suspension framing to minimize number of abutting end joints and avoid abutting end joints in central area of each ceiling.
2. Stagger abutting end joints of adjacent panels not less than one framing member.
3. Locate both edge or end joints of wallboards over intermediate supports or gypsum board back-blocking where framing is not present.

D. Typical Wall Applications:

1. Attach wallboards to studs so that leading edge or end of each board is attached to open (unsupported) edges of stud flanges first.
2. Stagger vertical joints on opposite sides of partitions.
3. Do not make joints other than control joints at corners of framed openings.
4. Attach wallboards to framing provided at doors, openings and cutouts. Install wallboards over door heads and extend to not less than one stud space (16 inches) at each side of door or opening.
5. Cover both faces of framing with wallboards as indicated, except in chase walls that are braced internally.
6. Cut and fit wallboards around ducts, pipes, conduits, and other penetrations to form proper annular joint to receive firestopping.
7. Where partitions intersect open building structure members projecting below underside of floor slabs and roof decks, cut to fit profile formed by coffers, joists, beams, and other structural members; form proper annular joint to receive firestopping.
8. Support both edge and end joints of wallboards over framing.

E. Nail Fastening:

1. Attach wallboard to wood framing with nails for wallboard being installed:
 - a. Type shall be appropriate for material and conditions.
 - b. Length shall be as required by condition and penetrating wood framing not less than 1/2 inches.
 - c. Spacing shall be as recommended by installation quality standard, wallboard manufacturer or respective assembly test report.
2. Drive nails to slightly dimple surface without breaking face paper, fracturing core, or stripping wood framing member around fastener shank.
3. Space nails for non-fire resistance rated partitions and ceilings as recommended by installation quality standards.
4. Space nails for fire resistance rated partitions as required by assembly fire test reports.
5. Start field nailing near center and work towards edges.
6. Space nails not less than 3/8 inches from wallboards edges.

F. Control Joints: Form control joints and expansion joints at locations indicated with required space between edges of adjoining wallboards.

3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- C. Repair of Gypsum Board:
 - 1. Patch holes and voids in gypsum board utilizing mesh and bonding primer – hot patching is not acceptable.
 - 2. Patch and Repair fire resistance rated gypsum board assemblies in accordance with Gypsum Association GA-225.

3.7 ADJUSTMENTS

- A. Wet Materials: Materials and products that are wet or have been wet at any time during construction shall be replaced with new and dry materials and products.

END OF SECTION

SECTION 092920
FINISHING GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Finishing of gypsum board (taping and bedding).
2. Accessories indicated, specified, or required to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each product.

1.3 QUALITY ASSURANCE

- A. Comply with requirements of GA 216 and ASTM C840.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 FIELD CONDITIONS

- A. Environmental Conditions: Establish and maintain environmental conditions for finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.
- B. Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 JOINT TREATMENT MATERIALS

- A. Material Quality Standard: ASTM C475.

B. Joint Tape:

1. Paper Tape: Nominal 2 inch wide cross-fibered paper tape with finish suitable for bonding, creased in center for easy folding, and compatible with joint compound.
2. Mesh Tape: Nominal 2 inch wide self-adhering 10-by-10 fiberglass mesh tape.

C. Joint Compound:

1. Setting-Type: Job-mixed powder for mixing with water, chemical-hardening compound; includes taping types.
2. Drying-Type: Ready-mixed or job-mixed powder for mixing with water, air-drying, vinyl based compounds; includes taping, topping, and all-purpose types.

PART 3 - EXECUTION**3.1 EXAMINATION****A. Acceptance of Surfaces and Conditions:**

1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 JOINT TREATMENT FINISHING GYPSUM BOARD

- A. Treat gypsum board joints, interior and exterior angles, flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Gypsum Board: Finish gypsum board to levels indicated below according to ASTM C840 and GA-214:
 1. Level 1: Not Used.
 2. Level 2: Not Used.
 3. Level 3: Not Used.
 4. Level 4: Surfaces to receive paint.
 5. Level 5: Not Used.

END OF SECTION

SECTION 095113
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Acoustical panels.
 2. Exposed suspension system.
 3. Related materials necessary to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each type of product indicated, specified, or required.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
1. Acoustical Panels: Set of 6 inch square Samples of each type, color, pattern, and texture.
 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6 inch long Samples of each type, finish, and color.
- C. Maintenance Data: For inclusion in maintenance manual required by appropriate Division 01 Section.
1. Include manufacturer's instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified on the Drawings to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

2.2 ACOUSTICAL PANELS

- A. Acoustical Panels:
 - 1. Standard: Comply with ASTM E1264.
 - 2. Products that are equivalent to color, texture, pattern, finish, appearance, and material quality characteristics indicated by basis of design selection.

2.3 METAL SUSPENSION SYSTEM

- A. Metal Suspension System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635 and designated by type, structural classification, and finish indicated.
- B. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A641, Class 1 zinc coating, soft temper.
 - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch diameter wire.
- C. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
- D. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653, not less than G30 coating designation, with prefinished wide metal caps on flanges, width as indicated.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Butt-edge type.
 - 3. Cap Material: Cold-rolled steel.
 - 4. Cap Finish: Painted white.
 - 5. Width: 9/16 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates, areas, and conditions to verify actual locations, dimensions, and other conditions affecting performance of the Work.

2. Proceed with installation only after unsatisfactory conditions have been corrected.
3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. Installation Quality Standards: In addition to standards specified elsewhere, comply with the following:
 1. ASTM C636.
 2. Cisca's "Ceiling Systems Handbook."
 3. Manufacturer's written installation instructions.
- B. Layout: Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- C. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Space hangers not more than 48 inches on centers along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- D. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to steel deck.
- E. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- F. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- G. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- H. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to **long** axis of space.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.3 INSTALLATION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

3.5 ADJUSTING

- A. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096139
SEALING CONCRETE FLOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Sealing of interior concrete floors.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for concrete sealer.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

1. Manufacturer: The Euclid Chemical Co.
2. Product: Euco Diamond Hard.

- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

1. Dayton Superior.
2. The Euclid Chemical Co.
3. Laticrete.
4. W. R. Meadows, Inc.
5. Sika Corp.

2.2 MATERIALS

- A. Concrete Sealer: Clear, water-based liquid consisting of proprietary blend of silicates and silicate polymers that penetrates concrete surfaces and chemically reacts to increase surface density, durability, and abrasion resistance; dust-proofs concrete; USDA compliant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:

1. Examine substrates to which sealing concrete floors will be applied for compliance with requirements and other conditions affecting performance.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 APPLICATION

- A. Apply sealer according to manufacturer's written instructions.

END OF SECTION

SECTION 096513
RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Accessories indicated, specified, or required to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- C. Maintenance Data: For inclusion in maintenance manual required by appropriate Division 01 Section.
1. Include manufacturer's instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 Watt per square centimeter.

1.4 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified on the Drawings to establish a standard of quality. Other manufacturers with products having equivalent

characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

2.2 RESILIENT BASE

A. Resilient Base Standard: ASTM F1861.

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Inside and Outside Corners: Job formed.
4. Rolled/coiling products.

B. Minimum Thickness: 0.125 inch.

2.3 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

END OF SECTION

SECTION 096520
RUBBER SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Rubber sheet flooring and accessories indicated, specified, or required to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's technical product literature for each type of product.
- B. Samples: Full-size units of each color and pattern of tile flooring required.
- A. Maintenance Data: For inclusion in maintenance manual required by appropriate Division 01 Section.
 - 1. Include manufacturer's instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 - 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration.
 - 1. Store rolls upright.

1.4 FIELD CONDITIONS

- A. Adhesively Applied Products:
 - 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
 - 3. Close spaces to traffic during flooring installation.
 - 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOOR

- A. Product Standard: ASTM F1860.

1. Type: Type I, homogeneous rubber sheet floor covering with backing.
2. Wear-Layer Thickness: As standard with manufacturer.
3. Overall Thickness: As standard with manufacturer.
4. Backing: Foamed rubber.
5. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.

B. Wearing Surface: Smooth.

C. Sheet Width: As standard with manufacturer.

D. Seamless-Installation Method: Heat welded.

E. Colors and Patterns: As selected by Architect from full manufacturer's range.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit flooring and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
2. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine surfaces and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

A. Prepare substrates according to flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by flooring manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install flooring until materials are the same temperature as space where they are to be installed.
 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring.
- B. Unroll flooring and allow it to stabilize before cutting and fitting.
- C. Lay out flooring as follows:
 1. Maintain uniformity of flooring direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 3. Match edges of flooring for color shading at seams.
 4. Avoid cross seams.
- D. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Seamless Installation:
 1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting flooring.
- B. Perform the following operations immediately after completing flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover flooring until Substantial Completion.

END OF SECTION

SECTION 096723
RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Resinous flooring systems.

1.2 SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- C. Maintenance Data: For inclusion in maintenance manual required by Section 01 77 00 – Closeout Procedures.
1. Include manufacturer's instructions for maintenance of installed Work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified on Drawings to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.

2.2 RESINOUS FLOORING

- A. Elastomeric Flooring System: Textured, for slip resistance as selected from manufacturers' full range:
 - 1. First Coat: Primer.
 - 2. Second Coat: Urethane coating membrane.
 - 3. Third Coat: Urethane coating membrane.
 - 4. Top Coat: Two part, 100 percent solids epoxy resin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates to which resinous flooring will be applied for compliance with requirements and other conditions affecting performance.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
- C. Perform preinstallation testing specified by Section 09 05 61 - Moisture Vapor Emission Control and provide MVE-control systems products for those floor surfaces that do not comply with requirements.
- D. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- E. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.3 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Reinforcing Membrane: Apply reinforcing membrane to entire substrate surface.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 1. Integral Cove Base: 6 inches high.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- G. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.4 FIELD CONTROL TESTING

- A. Water test each shower/toilet room.

3.5 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 099100
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation and field painting of exposed exterior and interior surfaces.

1.2 SUBMITTALS

- A. Product Data: Manufacturers technical literature for each paint system indicated, specified, or required.
1. Indicate each material and cross-reference specific coating, finish system, and application.
 2. Identify each material by manufacturer's catalog number and general classification.
 3. Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Detailed Painting Schedule:
1. Furnish "Detailed Painting Schedule" indicating type of surface, type of paint material, and number of coats required, as set forth in "Painting Requirements".
 2. Submit brand designation and grade of indicated type produced by approved manufacturer for each application listed or required.
- C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate, 8 by 10 inches.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: Company with not less than 5 years' experience in performing specified work similar in design, products, and extent indicated for this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required Work.
- B. Mockups: Before work of this Section begins, apply coatings to demonstrate product and material qualities, to demonstrate execution of work qualities, and to verify compliance with Contract Documents. Duplicate finish of approved Sample Submittals.
1. Apply paint to following substrates:
 - a. Wall Surfaces: Apply coating on approximately 48 inch square substrate.
 - b. Linear Items: Apply coating on approximately 48 inch long substrate.
 2. Use same Subcontractors, including supervisors, which will perform work on Project.
 3. Install products according to specified requirements.
 4. Work shall be representative of those to be expected for work.
 5. Obtain approval from Architect before starting work of this Section.

6. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-up unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mock-up may become part of the completed Work if undisturbed at time of Substantial Completion.
8. Final approval of colors will be from mockups.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature recommended by manufacturer. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.5 FIELD CONDITIONS

- A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between minimum and maximum range recommended by manufacturer.
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces unless otherwise permitted by manufacturer's printed instructions.
- C. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature and humidity limits specified by manufacturer during application and drying periods.

1.6 MAINTENANCE

- A. Extra Materials: Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 1. Quantity: Furnish the Owner with an additional 3 percent, but not less than 1 gallon or 1 case, as appropriate, of each material and color applied.
 2. Label each container with color, color number, and texture in addition to manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products manufactured by Sherwin-Williams Co. listed under PART 3 below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."
 1. Benjamin Moore & Co.
 2. PPG Paints.

3. Sherwin-Williams.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other listed acceptable manufacturers.
- C. Colors: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 1. Examine substrates to receive paint and associated Work for compliance with requirements and other conditions affecting performance.
 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 3. Starting Work within a particular area will be construed as acceptance of surface conditions.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to shop applicators to ensure use of compatible primers.

3.2 PREPARATION

- A. General:
 1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted.
 2. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 3. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Surface Preparation: Prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition. Clean substrates of substances that could impair the bond of the various coatings.
 1. Gypsum Board: Comply with Gypsum Association Publication GA 232.
 - a. Fill remaining cracks, depressions, holes and other irregularities with spackling compound.
 - b. Sand rough or high spots left by joint cement or spackling compound without damaging paper face.
 - c. Remove dust by wiping with damp cloths or vacuuming.

2. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
3. Ungalvanized Metal Surfaces:
 - a. Clean surfaces that have not been shop coated to remove foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
4. Galvanized Metal Surfaces:
 - a. Clean galvanized surfaces free of oil and surface contaminants.
 - b. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

3.3 MATERIAL PREPARATION

- A. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Use only thinners approved by paint manufacturer and only within manufacturer's recommended limits.
- B. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION, GENERAL

- A. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 1. Prefinished items include the following factory-finished components:
 - a. Prefinished wood doors.
 - b. Acoustical materials.
 - c. Prefinished architectural woodwork and cabinets.
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.

c. Pipe spaces.

3. Finished metal surfaces.
4. Finished mechanical and electrical operating equipment.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.5 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
 5. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Sand lightly between each succeeding enamel coat on metals.
 10. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation.
 11. Number of coats and film thickness required are the same regardless of application method.
 12. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 13. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 14. Omit primer over metal surfaces that have been shop primed and touchup painted.
 15. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.
 16. Ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 17. Allow sufficient time between successive coats to permit proper drying.
- B. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve total dry film thickness of the entire system as recommended by manufacturer.
- C. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- D. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- E. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.6 ADJUSTING

- A. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 CLEANING

- A. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.8 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repainting, repairing or replacing. Coordinate corrections with other trades involved.

3.9 INTERIOR PAINT SCHEDULE

A. Gypsum Board Walls - Latex - Eg-shel:

1. 1st Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
2. 2nd Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex - Low Gloss Eg-Shel, B41-2600.
3. 3rd Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex - Low Gloss Eg-Shel, B41-2600.

B. Gypsum Board Ceilings - Latex - Flat:

1. 1st Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
2. 2nd Coat: Sherwin Williams; ProMar 200 Zero VOC Latex Flat, B30-2600.
3. 3rd Coat: Sherwin Williams; ProMar 200 Zero VOC Latex Flat, B30-2600.

C. Ferrous Metal - Acrylic Polyurethane - Semi-Gloss:

1. First Coat: Sherwin Williams; Macropoxy 646 Fast Cure Epoxy, B58-600.
2. Second Coat: Sherwin Williams; Acrolon 218 HS Acrylic Polyurethane, B65-650.
3. Third Coat: Sherwin Williams; Acrolon 218 HS Acrylic Polyurethane, B65-650.

D. Wood - Latex - Eg-shel:

1. 1st Coat: Sherwin Williams; Premium Wall & Wood Interior Latex Primer, B28W08111.
2. 2nd Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex - Low Gloss Eg-Shel, B41-2600.
3. 3rd Coat: Sherwin Williams; ProMar 200 Zero VOC Interior Latex - Low Gloss Eg-Shel, B41-2600.

E. Concrete Unit Masonry - Latex - Eg-Shel:

1. Prime Coat: Sherwin Williams; PrepRite Block Filler, B25W25.
2. Intermediate Coat: Sherwin Williams; ProMar 200 Zero VOC Latex Eg-Shel, B20-2600.
3. Topcoat: Sherwin Williams; ProMar 200 Zero VOC Latex Eg-Shel, B20-2600.

3.10 EXTERIOR PAINT SCHEDULE

A. Galvanized Ferrous Metal - Acrylic - Semi-Gloss:

1. First Coat: Sherwin Williams; ProCryl Universal Metal Primer, B66-1300.
2. 2nd Coat: Sherwin Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650.
3. 3rd Coat: Sherwin Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650.

B. Ferrous Metal - Acrylic - Semi-Gloss:

1. First Coat: Sherwin Williams; ProCryl Universal Metal Primer, B66-1300
2. 2nd Coat: Sherwin Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650.
3. 3rd Coat: Sherwin Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650.

C. Portland Cement Plaster and Stucco – Satin:

1. First Coat: Sherwin Williams; Loxon Concrete & Masonry Primer, LX2W50.
2. Second Coat: Sherwin Williams; ConFlex XL Elastomeric High Build Coating, CF11W50.
3. Third Coat: Sherwin Williams; SuperPaint Exterior Latex, A89.

END OF SECTION

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets.
2. Portable fire extinguishers
3. Related materials necessary for installation.

1.2 SUBMITTALS

A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required.

1. Cabinets: Roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Fire Extinguishers: Rating and classification, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Manufacturer's Special Warranty: Sample of unexecuted warranty stating obligations, remedies, limitations, and exclusions.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10.

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.4 WARRANTY

A. Special Manufacturer's Warranty: Standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fails in materials or workmanship within 6 years from date of Substantial Completion.

B. Failures include, but are 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. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Division 01 Section "Substitution Procedures."

1. Babcock Davis.
2. JL Industries.
3. Larsen's Manufacturing Company.
4. Nystrom Building Products.
5. Potter Roemer.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. General: Type, size, and capacity for each fire protection cabinet indicated.
1. Valves: Manufacturer's standard.
 2. Handles and Levers: Manufacturer's standard.
 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Located at Fire Protection Cabinets: Multipurpose dry-chemical Type; UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 FIRE PROTECTION CABINETS

- A. Type: Nonrated, suitable for fire extinguisher and wall construction.
- B. Cabinet and Door Material: Stainless steel; ASTM A666, Type 304.
1. Finish: ASTM A480 No. 4 directional satin finish.
- C. Cabinet and Door Material: Cold-rolled steel; ASTM A1008, Commercial Steel (CS), Type B.
1. Factory Primed Door and Trim: Manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- D. Recessed Mounted Cabinets: Tub fully recessed; one-piece combination steel flat trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend) of 1/4 to 5/16 inch.
- E. Semirecessed Mounted Cabinet: Tub semirecessed; one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
1. Square-Edge Trim: 1-1/4 to 1-1/2 inch backbend depth.
 2. Rolled-Edge Trim: 2-1/2 inch backbend depth.
- F. Surface Mounted Cabinet: Cabinet tub and door fully exposed and mounted directly on wall with no trim.
- G. Door Style: Solid panel with frame.
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Projecting door pull and friction latch.
2. Continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

2.4 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 1. Fabricate door frames with tubular stiles and rails and hollow metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 1. Examine substrates to receive fire protection specialties and associated Work for compliance with requirements and other conditions affecting performance.
 - a. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 3. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fasten cabinets to structure square, level and plumb.

3.3 ADJUSTING

- A. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

END OF SECTION

SECTION 105613
METAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal cabinets
 - 2. Related materials necessary to complete installation.

1.2 SUBMITTALS

- A. Product Data: Manufacturers technical literature for each type of product indicated, specified, or required.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication, assembly, and installation details. Show complete extent of cabinet installation.
 - 1. Include layout, dimensions, and identification of each unit corresponding to sequence of installation procedures.
 - 2. Include installation details.
- C. Samples: Color chips of manufacturer's standard colors available.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver cabinets only when painting and similar operations that could damage cabinets have been completed in installation areas.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on products specified on the Drawings to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as judged by Architect

2.2 CONSTRUCTION

- A. Fully assembled.
- B. 1.2mm (18 gauge) solid welded steel construction with integral cabinet legs.
- C. Soft closing doors.
- D. Ball bearing drawer slides.
- E. 200 pound load rating.

- F. Zero clearance adjustable Euro hinges.
- G. Full slotted back panels for wall mounting.
- H. Full length solid core aluminum handles.
- I. Adjustable shelves.

2.3 FABRICATION

- A. Fabricate cabinets square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

2.4 METAL FINISHES

- A. Factory finish metal surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Components painted with electrostatically applied powder coating according to ASTM D3451.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions:
 - 1. Examine substrates to receive metal cabinets and associated work for compliance with requirements and other conditions affecting performance.
 - 2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
 - 3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

- A. General: Install level, plumb, and true according to manufacturer's written instructions.

3.3 PROTECTION

- A. Protect cabinets against damage during remainder of construction period.

END OF SECTION

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal-bellows packless expansion joints.
 - 2. Pipe loops and swing connections.
 - 3. Alignment guides and anchors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

- A. Metal-Bellows Packless Expansion Joints:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adsko Manufacturing LLC.
 - b. American BOA, Inc.
 - c. Badger Industries, Inc.
 - d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex Pression Ltd.
 - h. Flex-Weld, Inc.
 - i. Flo Fab inc.
 - j. Hyspan Precision Products, Inc.
 - k. Metraflex, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics Pathway.
 - n. Tozen Corporation.
 - o. Unaflex.
 - p. Unisource Manufacturing, Inc.
 - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
 - r. U.S. Bellows, Inc.
 - s. WahlcoMetroflex.
 - 3. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 - 4. Type: Circular, corrugated bellows with external tie rods.
 - 5. Minimum Pressure Rating: 175 psig (1200 kPa) unless otherwise indicated.
 - 6. Configuration: Single joint class(es) unless otherwise indicated.
 - 7. Expansion Joints for Copper Tubing: Single phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
 - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

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2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

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3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install **one** guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, product indicated on drawings.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide indicated on Drawings or comparable product by one of the following:
1. Ashcroft Inc.
 2. Ernst Flow Industries.
 3. Marsh Bellofram.
 4. Miljoco Corporation.
 5. Nanmac Corporation.
 6. Noshok.
 7. Palmer Wahl Instrumentation Group.
 8. REOTEMP Instrument Corporation.
 9. Tel-Tru Manufacturing Company.
 10. Terice, H. O. Co.

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11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 12. Weiss Instruments, Inc.
 13. WIKA Instrument Corporation - USA.
 14. Winters Instruments - U.S.
- C. Standard: ASME B40.200.
- D. Case: Liquid-filled type(s); stainless steel with 3-inch nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- G. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- H. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- I. Window: Plain glass or plastic.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1.5 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Manufacturers: Subject to compliance with requirements, product indicated on drawings:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Terice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 3. Standard: ASME B40.200.
 4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 5. Case Form: Adjustable angle unless otherwise indicated.
 6. Tube: Glass with magnifying lens and blue or red organic liquid.
 7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 8. Window: Glass or plastic.
 9. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

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11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, products indicated on drawings.
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
3. Standard: ASME B40.200.
4. Case: Plastic, 7-inch nominal size unless otherwise indicated.
5. Case Form: Adjustable angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass or plastic.
9. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

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2.4 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, product indicated on drawings:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
 3. Standard: ASME B40.100.
 4. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 6. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 9. Pointer: Dark-colored metal.
 10. Window: Glass or plastic.
 11. Ring: Metal Brass Stainless steel.
 12. Accuracy: Grade B, plus or minus 2 percent of middle half of] [Grade C, plus or minus 3 percent of middle half of scale range.
- B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, product indicated on drawings:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.
 - i. Tel-Tru Manufacturing Company.
 - j. Terice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. WIKA Instrument Corporation - USA.
 - m. Winters Instruments - U.S.

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3. Standard: ASME B40.100.
 4. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 9. Pointer: Dark-colored metal.
 10. Window: Glass or plastic.
 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, product indicated on drawings:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
 3. Standard: ASME B40.100.
 4. Case: Liquid-filled; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 9. Pointer: Dark-colored metal.
 10. Window: Glass or plastic.
 11. Ring: Metal.
 12. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, product indicated on drawings:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. Noshok.

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- e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Tel-Tru Manufacturing Company.
 - h. Trerice, H. O. Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instrument Corporation - USA.
 - k. Winters Instruments - U.S.
- 3. Standard: ASME B40.100.
 - 4. Case: Sealed type; plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
 - 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 9. Pointer: Dark-colored metal.
 - 10. Window: Glass or plastic.
 - 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.

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- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- K. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.
- C. Scale Range for Domestic Cold-Water Piping: 30 to 240 deg F and 0 to plus 115 deg C.
- D. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

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- E. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F and 0 to 150 deg C.
- F. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.
- G. Scale Range for Domestic Cooled-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

3.4 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be[one of] the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi and 0 to 600 kPa.
- B. Scale Range for Water Service Piping: 0 to 160 psi and 0 to 1100 kPa.
- C. Scale Range for Water Service Piping: 0 to 200 psi and 0 to 1400 kPa.
- D. Scale Range for Domestic Water Piping: 0 to 100 psi and 0 to 600 kPa.
- E. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.
- F. Scale Range for Domestic Water Piping: 0 to 200 psi and 0 to 1400 kPa.

END OF SECTION 220519

SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.

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- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.

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- e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Hammond Valve.
 - b. Jamesbury; a subsidiary of Metso Automation.
 - c. Legend Valve.
 - d. Marwin Valve; a division of Richards Industries.
 - e. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.3 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.

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- c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DynaQuip Controls.
 - f. Hammond Valve.
 - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - 2. Description:

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- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.

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- e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - l. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.

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- f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - l. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated ductile iron.

2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.

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- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Sure Flow Equipment Inc.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - 2. Description:

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- a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.

2.7 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.

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- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.8 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.

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- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- k. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.

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- f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
2. Description:
- a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
- 2. Description:

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- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
- 2. Attachment: For connection to butterfly valve stems.
- 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
- 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

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PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly, gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
 - 1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Globe, ball, or butterfly valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

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5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG ([1035 kPa]) OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, regular port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, ductile-iron disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, NRS.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG ([1035 TO 1380 kPa]))

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, regular port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, NRS.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: One piece, regular port, brass or bronze with brass trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.

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6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron Gate Valves: Class 125, NRS.
6. Iron Globe Valves: Class 125.

3.7 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, regular port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
4. Iron Gate Valves: Class 125, NRS.
5. Iron Globe Valves: Class 125.

END OF SECTION 220523.12

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

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1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.

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2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
- a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

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- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.6 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.

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- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

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- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.

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3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

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3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

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3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restraining braces and cables.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I
 - a. Component Importance Factor: 1.5
 - b. Component Response Modification Factor: 2.5.
 - c. Component Amplification Factor: 2.5.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
4. Design Spectral Response Acceleration at 1-Second Period:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

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- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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 unavailable, 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.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

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2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts : All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

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1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

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PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. 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.

3.2 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an evaluation service an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 3. Brace a change of direction longer than 12 feet (3.7 m).
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- G. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

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3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 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 at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.

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- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. 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.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. 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:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Blue.

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END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Polyolefin.
 - e. Polystyrene.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS**A. Product Data:** For each type of product indicated.**B. LEED Submittal:**

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.

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4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

D. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
- I. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.
 - d. Rock Wool Manufacturing Company; Delta Board.
 - e. Roxul Inc.; Roxul RW.
 - f. Thermafiber; Thermafiber Industrial Felt.
- J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.

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- d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, [without factory-applied jacket] [with factory-applied ASJ] [with factory-applied ASJ-SSL]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied [ASJ] [FSK jacket] complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- L. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- M. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Aeroflex USA Inc.; Aeroseal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.

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- b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 4. Permanently flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 100 to plus 300 deg F.
 6. Color: White or gray.
 7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

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1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

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2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color as selected by Architect.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 5. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper thick Polysurlyn].
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.

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- h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

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- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches.
 3. Film Thickness: 4 mils.
 4. Adhesive Thickness: 1.5 mils.
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products; Bands.
- b. PABCO Metals Corporation; Bands.
- c. RPR Products, Inc.; Bands.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

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- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

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2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

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1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches** o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

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3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

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1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **100** percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.

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3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

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- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

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2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:

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1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

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2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

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1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of

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jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.12 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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3.14 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, Exposed Breeching and Connector Insulation: High-temperature mineral-fiber **blanket**, 3 inches thick and 3-lb/cu. ft. nominal density.
- B. Round, Concealed Breeching and Connector Insulation: High-temperature mineral-fiber **blanket**, 3 inches thick and 3-lb/cu. ft. nominal density.

3.15 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-Exchanger (Water-to-Water for Domestic Water Heating Service) Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.
- D. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be[one of] the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Pipe and Tank: 1 inch thick.
 - 3. Polyolefin: 1 inch thick.
- E. Domestic Hot-Water Storage Tank Insulation: Mineral-Fiber Pipe and Tank: Of thickness to provide an R-value of 12.5.
- F. Piping System Filter-Housing Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.

3.16 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.17 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot, and Recirculated Hot Water: Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3/4 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 3. Polyolefin: 3/4 inch thick.

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- B. Domestic Chilled Water (Potable): Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 3. Polyolefin: 1 inch thick.
- C. Stormwater and Overflow: Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 3. Polyolefin: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 3. Polyolefin: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
1. Flexible Elastomeric: 3/4 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 3. Polyolefin: 3/4 inch thick.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- G. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. Flexible Elastomeric: 3/4 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 3. Polyolefin: 3/4 inch thick.

3.18 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping: Insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.
 2. Flexible Elastomeric: 2 inches thick.
 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 4. Polyolefin: 2 inches thick.
 5. Polystyrene: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.

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2. Flexible Elastomeric: 2 inches thick.
 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 4. Polyolefin: 2 inches thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be one of the following:
1. Cellular Glass: 2 inches thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.19 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.20 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
1. None.
 2. PVC, Color-Coded by System: 30 mils thick.
 3. Aluminum, Corrugated: 0.024 thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. None.
 2. PVC: 30 mils thick.
 3. Aluminum, Smooth: 0.024 inch thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches.
1. None.
 2. Aluminum, Smooth with 1-1/4-Inch-Deep Corrugations thick.
- F. Piping, Concealed:
1. None.
 2. PVC, Color-Coded by System: 30 mils thick.
 3. Aluminum, Corrugated: 0.024 inch thick.

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G. Piping, Exposed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Smooth: 0.032 inch thick.

3.21 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC: 30 mils thick.
3. Aluminum, Corrugated: 0.024 thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Smooth: 0.032 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Aluminum, Smooth with 1-1/4-Inch-Deep Corrugations: 0.032 inch thick.

F. Piping, Concealed:

1. None.
2. PVC: 30 mils thick.
3. Aluminum, Corrugated: 0.032 inch.

G. Piping, Exposed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth: 0.020 thick.

3.22 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.
4. Water meters furnished by utility company for installation by Contractor.
5. Water meters.
6. Escutcheons.
7. Sleeves and sleeve seals.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

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PART 2 - PRODUCTS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) NVent LLC.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

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2.3 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight. Include ends matching joining method.
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
 - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
 - 4. Flanges: ASME B16.1, Class 125, cast iron.

2.4 CPVC PIPING

- A. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.5 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.6 PVC PIPE AND FITTINGS

- 1. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.

2.7 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.8 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. CPVC Union Ball Valves:
 1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig.
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - g. Ball: CPVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.
- D. PVC Union Ball Valves:
 1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig.
 - c. Body Material: PVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - g. Ball: PVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.
- E. PVC Butterfly Valves:
 1. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: PVC.
 - c. Body Design: Lug or wafer type.

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- d. Seat: EPDM rubber.
 - e. Seals: PTFE or EPDM-rubber O-rings.
 - f. Disc: PVC.
 - g. Stem: Stainless steel.
 - h. Handle: Lever.
- F. CPVC Ball Check Valves:
- 1. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: CPVC.
 - c. Body Design: Union-type ball check.
 - d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - f. Ball: CPVC.
 - g. Seals: EPDM- or FKM-rubber O-rings.
- G. PVC Ball Check Valves:
- 1. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: PVC.
 - c. Body Design: Union-type ball check.
 - d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - f. Ball: PVC.
 - g. Seals: EPDM- or FKM-rubber O-rings.
- H. CPVC Gate Valves:
- 1. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: CPVC.
 - c. Body Design: Nonrising stem.
 - d. End Connections for Valves NPS 2 and Smaller: Socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - f. Gate and Stem: Plastic.
 - g. Seals: EPDM rubber.
 - h. Handle: Wheel.
- I. PVC Gate Valves:
- 1. Description:
 - a. Pressure Rating: 150 psig at 73 deg F.
 - b. Body Material: PVC.
 - c. Body Design: Nonrising stem.
 - d. End Connections for Valves NPS 2 and Smaller: Socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Flanged.
 - f. Gate and Stem: Plastic.
 - g. Seals: EPDM rubber.
 - h. Handle: Wheel.

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2.9 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.10 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
 - 1. Description:

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- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.11 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.12 WATER METERS

- A. Displacement-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
- B. Compound-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. Pipe Connections: Flanged.
- C. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

2.13 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated or rough-brass finish with setscrews.

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- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.14 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.15 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.16 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.

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- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

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- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX piping with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- U. Install thermometers on[**inlet and**] outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

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- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- I. Joints for PEX Piping: Join according to ASTM F 1807.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition **fittings or unions**.

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3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 WATER METER INSTALLATION

- A. Rough-in domestic water piping, and install water meters according to utility company's requirements.
- B. Water meters will be furnished and installed by utility company.
- C. Install water meters according to AWWA M6, utility company's requirements, and the following:
- D. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- E. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
- F. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

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- b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 - 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
- J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- L. Install hangers for vertical PEX piping every 48 inches.
- M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
 - 2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.

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- N. Install supports for vertical PVC piping every 48 inches.
- O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.

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5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split casting, cast brass.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.12 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using **sleeve seals** specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.

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- 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.13 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

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- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.16 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

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3.17 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6, shall be one of the following:
 - 1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
 - 2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 4. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
 - 5. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.
 - 6. PEX Tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
 - 7. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 - 5. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.
- H. Aboveground domestic water piping, NPS 5 and NPS 6, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.

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2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
4. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

3.18 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. CPVC and PVC valves matching piping materials may be used.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.

B. See Division 22 Section "Domestic Water Piping" for water meters.

C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

D. See Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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1.6 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.

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3. Standard: ASSE 1001.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1012.
4. Operation: Continuous-pressure applications.
5. Size: NPS 3/4 (DN 20)
6. Body: Bronze.
7. End Connections: Union, solder joint.
8. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
4. Standard: ASSE 1013.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
7. Size: 3/4"
8. Design Flow Rate: 0.5 GPM

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9. Selected Unit Flow Range Limits: 0.5 GPM
10. Pressure Loss at Design Flow Rate: 10 PSI for sizes NPS 2 (DN 50) and smaller;
11. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
12. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
13. Configuration: Designed for horizontal, straight through flow.
14. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Backflow-Preventer Test Kit:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
4. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
5. Size: $\frac{3}{4}$ "
6. Design Flow Rate: 61 GPM
7. Design Inlet Pressure: 116 PSI
8. Design Outlet Pressure Setting: 75 PSI

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9. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
10. Valves for Booster Heater Water Supply: Include integral bypass.
11. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
5. Size: NPS 2 (DN 50) or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.

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- g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
 - 4. Standard: ASSE 1017.
 - 5. Pressure Rating: 125 psig (860 kPa).
 - 6. Type: Thermostatically controlled water mixing valve.
 - 7. Material: Bronze body with corrosion-resistant interior components.
 - 8. Connections: Threaded union inlets and outlet.
 - 9. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 10. Tempered-Water Setting: 110 deg F
 - 11. Tempered-Water Design Flow Rate: 0.5 GPM
 - 12. Valve Finish: Chrome plated.
- B. Primary, Thermostatic, Water Mixing Valves:
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
 - 4. Standard: ASSE 1017.
 - 5. Pressure Rating: 125 psig (860 kPa).
 - 6. Type: Exposed-mounting thermostatically controlled water mixing valve.
 - 7. Material: Bronze body with corrosion-resistant interior components.
 - 8. Connections: Threaded union inlets and outlet.
 - 9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 10. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
 - 11. Tempered-Water Setting: 120 deg. F.
 - 12. Tempered-Water Design Flow Rate: 0.5 GPM
 - 13. Selected Valve Flow Rate at 45-psig (310-kPa) Pressure Drop:
 - 14. Pressure Drop at Design Flow Rate:
 - 15. Valve Finish: Chrome plated Retain subparagraph below if cabinet is required.
 - 16. Cabinet: Factory-fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.

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2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm)
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm) Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm)
6. Drain: Pipe plug.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral **or** field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.

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- i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 4. Pressure Rating: 125 psig (860 kPa).
 - 5. Operation: Loose key.
 - 6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 7. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
 - 8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 9. Box: Deep, flush mounting with cover.
 - 10. Box and Cover Finish: Chrome plated.
 - 11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 - 12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 - 13. Operating Keys(s): One with each wall hydrant.
- B. Moderate-Climate Wall Hydrants:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 4. Pressure Rating: 125 psig (860 kPa).
 - 5. Operation: Loose key.
 - 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
 - 7. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7.
 - 8. Box: Deep, flush mounting with cover.
 - 9. Box and Cover Finish: Chrome plated.
 - 10. Outlet: Exposed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7.
 - 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 - 12. Operating Keys(s): One with each wall hydrant.
- C. Vacuum Breaker Wall Hydrants:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Mansfield Plumbing Products LLC.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Prier Products, Inc.
 - e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
3. Standard: ASSE 1019, Type A or Type B.
4. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
5. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
6. Pressure Rating: 125 psig (860 kPa).
7. Operation: Loose key or wheel handle.
8. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
9. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
10. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.9 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 3. Size: NPS 3/4 (DN 20).
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER-HAMMER ARRESTERS

- A. Water Hammer Arresters:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

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- g. Tyler Pipe; Wade Div.
- h. Watts Drainage Products Inc.
- i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASSE 1010 or PDI-WH 201.
- 4. Type: Copper tube with piston.
- 5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Valves:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
- 3. Standard: ASSE 1018.
- 4. Pressure Rating: 125 psig (860 kPa) minimum.
- 5. Body: Bronze.
- 6. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
- 7. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
- 8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

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- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, and pump.
- G. Install water hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Water pressure-reducing valves.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Supply-type, trap-seal primer valves.
- K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

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END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 SUBMITTALS

- A. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.
 - 1. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
 - 2. Pressure Fittings:
 - a. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
- D. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- E. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40, solid wall.

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1. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings and solvent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Copper DWV tube, copper drainage fittings, and soldered joints.
 5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 6. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, soil, waste, and vent piping NPS 5 shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Copper DWV tube, copper drainage fittings, and soldered joints.
 5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 6. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

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- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 4. Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 5. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

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- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.

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2. Use gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 : 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

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- G. Install supports for vertical cast-iron soil piping every 15 feet.
 - H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - I. Install supports for vertical steel piping every 15 feet.
 - J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - K. Install supports for vertical copper tubing every 10 feet.
 - L. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - M. Install supports for vertical ABS and PVC piping every 48 inches.
 - N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.6 CONNECTIONS
- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
 - B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties"

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2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.14.1.
5. Size: Same as connected piping.

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6. Body: Cast iron.
7. Cover: Cast iron with bolted access check valve.
8. End Connections: Hub and spigot or hubless.
9. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
10. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Size: Same as floor drain outlet.
4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
5. Size: Same as connected drainage piping
6. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
7. Closure: Countersunk plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.36.2M for adjustable housing cleanout.
 5. Size: Same as connected branch.
 6. Type: Adjustable housing.
 7. Body or Ferrule: Cast iron.
 8. Clamping Device: Not required.
 9. Outlet Connection: Inside calk.
 10. Closure: Brass plug with straight threads and gasket.
 11. Adjustable Housing Material: Cast iron with set-screws or other device.
 12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 13. Frame and Cover Shape: Round.
 14. Top Loading Classification: Extra Heavy Duty.
 15. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.36.2M. Include wall access.
 5. Size: Same as connected drainage piping.
 6. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 7. Closure: Countersunk plug.
 8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 9. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.

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10. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.6.3 with backwater valve.
5. Pattern: Area drain.
6. Body Material: Gray iron.
7. Seepage Flange: Not required.
8. Anchor Flange: Not required.
9. Clamping Device: Not required.
10. Outlet: Bottom.
11. Backwater Valve: Drain-outlet type.
12. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
13. Sediment Bucket: Not required.
14. Top or Strainer Material: Bronze.
15. Top of Body and Strainer Finish: Nickel bronze.
16. Top Shape: Round.
17. Top Loading Classification: Extra Heavy-Duty.
18. Funnel: Not required.
19. Inlet Fitting: Not required.
20. Trap Material: Bronze.
21. Trap Pattern: Deep-seal P-trap.
22. Trap Features: Cleanout.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft. thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.

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- F. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.

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- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Assemble open drain fittings and install with top of hub 1 inch above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

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- 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to

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identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Faucets for lavatories, bathtubs, bathtub/showers, showers, and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Dishwasher air-gap fittings.
7. Disposers.
8. Hot-water dispensers.
9. Water closets.
10. Urinals.
11. Lavatories.
12. Bathtubs.
13. Individual showers.
14. Kitchen sinks.
15. Service sinks.
16. Laundry trays.

B. Related Sections include the following:

1. Division 22 Section "Healthcare Plumbing Fixtures."
2. Division 22 Section "Emergency Plumbing Fixtures."
3. Division 22 Section "Security Plumbing Fixtures."
4. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

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1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit WE 2, 3.1 and 3.2: Documentation indicating flow and water consumption requirements.
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in 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.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Plastic Sinks: ANSI Z124.6.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 9. Vitreous-China Fixtures: ASME A112.19.2M.
 - 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.

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- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower and shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.

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9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Elkay Manufacturing Co.
 - g. Fisher Manufacturing Co.
 - h. Grohe America, Inc.
 - i. Just Manufacturing Company.
 - j. Kohler Co.
 - k. Moen, Inc.
 - l. Royal Brass Mfg. Co.
 - m. Sayco; a Briggs Plumbing Products, Inc. Company.
 - n. Speakman Company.
 - o. T & S Brass and Bronze Works, Inc.
 - p. Zurn Plumbing Products Group; Commercial Brass Operation.
 - q. Not used.
 - r. American Standard Companies, Inc.
 - s. Bradley Corporation.
 - t. Brasstech Inc.; Newport Brass Div.
 - u. Broadway Collection.
 - v. Central Brass Manufacturing Company.
 - w. Chicago Faucets.
 - x. Delta Faucet Company.
 - y. Eljer.
 - z. Elkay Manufacturing Co.
 - aa. Fisher Manufacturing Co.
 - bb. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - cc. Gerber Plumbing Fixtures LLC.
 - dd. Geberit Manufacturing, Inc.
 - ee. Grohe America, Inc.
 - ff. Hansgrohe Inc.
 - gg. Hydrotek International, Inc.
 - hh. Intersan Manufacturing Company.

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- ii. Just Manufacturing Company.
- jj. Kohler Co.
- kk. Moen, Inc.
- ll. Pegler, Ltd.
- mm. Price Pfister, Inc.
- nn. Rohl LLC.
- oo. Royal Brass Mfg. Co.
- pp. Sayco; a Briggs Plumbing Products, Inc. Company.
- qq. Speakman Company.
- rr. T & S Brass and Bronze Works, Inc.
- ss. Water Management, Inc.
- tt. Wolverine Brass, Inc.
- uu. Zurn Plumbing Products Group; Commercial Brass Operation.
- vv. Not used.
- ww. American Standard Companies, Inc.
- xx. Bradley Corporation.
- yy. Brasstech Inc.; Newport Brass Div.
- zz. Broadway Collection.
- aaa. Central Brass Manufacturing Company.
- bbb. Chicago Faucets.
- ccc. Delta Faucet Company.
- ddd. Eljer.
- eee. Elkay Manufacturing Co.
- fff. Fisher Manufacturing Co.
- ggg. Franke Consumer Products, Inc.; Kitchen Systems Div.
- hhh. Gerber Plumbing Fixtures LLC.
- iii. Geberit Manufacturing, Inc.
- jjj. Grohe America, Inc.
- kkk. Hansgrohe Inc.
- lll. Hydrotek International, Inc.
- mmm. Intersan Manufacturing Company.
- nnn. Just Manufacturing Company.
- ooo. Kohler Co.
- ppp. Moen, Inc.
- qqq. Paul Decorative Products.
- rrr. Pegler, Ltd.
- sss. Phoenix Products, Inc.
- ttt. Price Pfister, Inc.
- uuu. Rohl LLC.
- vvv. Royal Brass Mfg. Co.
- www. Sayco; a Briggs Plumbing Products, Inc. Company.
- xxx. Sterling Plumbing Group, Inc.
- yyy. St. Thomas Creations.
- zzz. Speakman Company.
- aaaa. Symmons Industries, Inc.
- bbbb. T & S Brass and Bronze Works, Inc.
- cccc. Water Management, Inc.
- dddd. WhiteRock Corp.
- eeee. Wolverine Brass, Inc.
- ffff. Zurn Plumbing Products Group; Commercial Brass Operation.

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- gggg. Not used.
 - hhhh. American Standard Companies, Inc.
 - iiii. Delta Faucet Company.
 - jjjj. Eljer.
 - kkkk. Gerber Plumbing Fixtures LLC.
 - llll. Moen, Inc.
 - mmmm. Phoenix Products, Inc.
 - nnnn. Sayco; a Briggs Plumbing Products, Inc. Company.
 - oooo. Sterling Plumbing Group, Inc.
 - pppp. WhiteRock Corp.
 - qqqq. Wolverine Brass, Inc.
 - rrrr. Not used.
 - ssss. Gerber Plumbing Fixtures LLC.
 - tttt. Phoenix Products, Inc.
 - uuuu. Sterling Plumbing Group, Inc.
 - vvvv. Zurn Plumbing Products Group; Wilkins Operation.
 - www. Not used.
4. Description: Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
- a. Body Material: Residential, nonmetallic underbody with nonmetallic cover plate.
 - b. Finish: Nonmetallic.
 - c. Maximum Flow Rate: 0.5 gpm.
 - d. Maximum Flow: 0.25 gal..
 - e. Centers: 3-3/8 inches Single hole.
 - f. Mounting: Deck, exposed.
 - g. Valve Handle(s): Knob, nonmetallic.
 - h. Inlet(s): NPS 3/8 tubing, with NPS 1/2 (DN 15) male adaptor.
 - i. Spout: Swing type.
 - j. Spout Outlet: Spray.
 - k. Not used.
 - l. Drain: Stopper with chain.
 - m. Tempering Device: Not required.

2.2 BATHTUB FAUCETS

A. Bathtub Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Brasstech Inc.; Newport Brass Div.
 - c. Broadway Collection.
 - d. Central Brass Manufacturing Company.
 - e. Delta Faucet Company.
 - f. Eljer.

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- g. Gerber Plumbing Fixtures LLC.
 - h. Grohe America, Inc.
 - i. Hansgrohe Inc.
 - j. Kohler Co.
 - k. Moen, Inc.
 - l. Paul Decorative Products.
 - m. Pegler, Ltd.
 - n. Powers; a Watts Industries Co.
 - o. Royal Brass Mfg. Co.
 - p. Sayco; a Briggs Plumbing Products, Inc. Company.
 - q. Speakman Company.
 - r. Sterling Plumbing Group, Inc.
 - s. St. Thomas Creations.
 - t. Symmons Industries, Inc.
 - u. T & S Brass and Bronze Works, Inc.
 - v. Wolverine Brass, Inc.
4. Description: Single-control mixing valve. Include hot- and cold-water indicators and tub spout. Coordinate faucet inlets with supplies.
- a. Body Material: Solid brass.
 - b. Finish: Polished chrome plate.
 - c. Mounting: Wall.
 - d. Valve Handle(s): Knob, nonmetallic.
 - e. Bathtub Spout: Chrome-plated brass.
 - f. Operation: Noncompression, manual.
 - g. Supply Connections: NPS 1/2.

2.3 BATHTUB/SHOWER FAUCETS

A. Bathtub/Shower Faucets:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Brasstech Inc.; Newport Brass Div.
 - c. Broadway Collection.
 - d. Central Brass Manufacturing Company.
 - e. Chicago Faucets.
 - f. Delta Faucet Company.
 - g. Eljer.
 - h. Gerber Plumbing Fixtures LLC.
 - i. Hansgrohe Inc.
 - j. Kohler Co.
 - k. Leonard Valve Company.
 - l. Moen, Inc.
 - m. Paul Decorative Products.
 - n. Pegler, Ltd.

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- o. Powers; a Watts Industries Co.
 - p. Price Pfister, Inc.
 - q. Rohl LLC.
 - r. Royal Brass Mfg. Co.
 - s. Sayco; a Briggs Plumbing Products, Inc. Company.
 - t. Speakman Company.
 - u. Sterling Plumbing Group, Inc.
 - v. St. Thomas Creations.
 - w. Symmons Industries, Inc.
 - x. T & S Brass and Bronze Works, Inc.
 - y. Wolverine Brass, Inc.
 - z. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
 - aa. Zurn Plumbing Products Group; Wilkins Operation.
 - bb. Not used.
 - cc. Broadway Collection.
 - dd. Hansgrohe Inc.
 - ee. Leonard Valve Company.
 - ff. Powers; a Watts Industries Co.
 - gg. T & S Brass and Bronze Works, Inc.
 - hh. Not used.
 - ii. Chicago Faucets.
 - jj. Grohe America, Inc.
 - kk. Lawler Manufacturing Co., Inc.
 - ll. T & S Brass and Bronze Works, Inc.
 - mm. Not used.
4. Description: Single-handle thermostatic/pressure-balance valve for bathtub and for shower. Include hot- and cold-water indicators; check stops; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies; coordinate outlet with diverter valve.
- a. Body Material: Solid brass with nonmetallic trim.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Diverter Valve: Integral with mixing valve.
 - e. Mounting: Wall.
 - f. Bathtub Spout: Chrome-plated brass with diverter.
 - g. Operation: Noncompression, manual.
 - h. Antiscald Device: Integral with mixing valve.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - j. Supply Connections: NPS 1/2.
 - k. Backflow Protection Device for Hand-Held Shower: Required.
 - l. Shower Head Type: Ball joint.
 - m. Shower Head Material: Combined, metallic and nonmetallic with chrome-plated finish.
 - n. Spray Pattern: Adjustable.
 - o. Integral Volume Control: Required.
 - p. Shower-Arm Flow-Control Fitting: Not required.

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2.4 SHOWER FAUCETS

A. Shower Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Brasstech Inc.; Newport Brass Div.
 - c. Broadway Collection.
 - d. Central Brass Manufacturing Company.
 - e. Chicago Faucets.
 - f. Delta Faucet Company.
 - g. Eljer.
 - h. Gerber Plumbing Fixtures LLC.
 - i. Hansgrohe Inc.
 - j. Kohler Co.
 - k. Leonard Valve Company.
 - l. Moen, Inc.
 - m. Paul Decorative Products.
 - n. Pegler, Ltd.
 - o. Powers; a Watts Industries Co.
 - p. Price Pfister, Inc.
 - q. Rohl LLC.
 - r. Royal Brass Mfg. Co.
 - s. Sayco; a Briggs Plumbing Products, Inc. Company.
 - t. Speakman Company.
 - u. Sterling Plumbing Group, Inc.
 - v. St. Thomas Creations.
 - w. Symmons Industries, Inc.
 - x. T & S Brass and Bronze Works, Inc.
 - y. Wolverine Brass, Inc.
 - z. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
 - aa. Zurn Plumbing Products Group; Wilkins Operation.
 - bb. Not used.
 - cc. Broadway Collection.
 - dd. Hansgrohe Inc.
 - ee. Leonard Valve Company.
 - ff. Powers; a Watts Industries Co.
 - gg. T & S Brass and Bronze Works, Inc.
 - hh. Not used.
 - ii. Chicago Faucets.
 - jj. Grohe America, Inc.
 - kk. Lawler Manufacturing Co., Inc.
 - ll. T & S Brass and Bronze Works, Inc.
 - mm. Not used.

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4. Description: Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - a. Body Material: Solid brass with nonmetallic trim.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Diverter Valve: Not required.
 - e. Mounting: Exposed.
 - f. Backflow Protection Device for Hand-Held Shower: Required.
 - g. Operation: Noncompression, manual.
 - h. Antiscald Device: Not required.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - j. Supply Connections: NPS 1/2, union.
 - k. Shower Head Type: Ball joint.
 - l. Shower Head Material: Nonmetallic with chrome-plated finish.
 - m. Spray Pattern: Adjustable.
 - n. Integral Volume Control: Not required.
 - o. Shower-Arm Flow-Control Fitting: Not required.
 - p. Temperature Indicator: Not required.

2.5 SINK FAUCETS

A. Sink Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Broadway Collection.
 - d. Chicago Faucets.
 - e. Delta Faucet Company.
 - f. Dormont Manufacturing Company.
 - g. Eljer.
 - h. Elkay Manufacturing Co.
 - i. Fisher Manufacturing Co.
 - j. Grohe America, Inc.
 - k. Just Manufacturing Company.
 - l. Kohler Co.
 - m. Moen, Inc.
 - n. Royal Brass Mfg. Co.
 - o. Sayco; a Briggs Plumbing Products, Inc. Company.
 - p. Speakman Company.
 - q. T & S Brass and Bronze Works, Inc.
 - r. Zurn Plumbing Products Group; Commercial Brass Operation.
 - s. Not used.

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t. American Standard Companies, Inc.
u. Bradley Corporation.
v. Brasstech Inc.; Newport Brass Div.
w. Broadway Collection.
x. Central Brass Manufacturing Company.
y. Chicago Faucets.
z. Delta Faucet Company.
aa. Eljer.
bb. Elkay Manufacturing Co.
cc. Fisher Manufacturing Co.
dd. Franke Consumer Products, Inc.; Kitchen Systems Div.
ee. Gerber Plumbing Fixtures LLC.
ff. Grohe America, Inc.
gg. Hansgrohe Inc.
hh. Hydrotek International, Inc.
ii. Intersan Manufacturing Company.
jj. Just Manufacturing Company.
kk. Kohler Co.
ll. Moen, Inc.
mm. Pegler, Ltd.
nn. Price Pfister, Inc.
oo. Rohl LLC.
pp. Royal Brass Mfg. Co.
qq. Sayco; a Briggs Plumbing Products, Inc. Company.
rr. Speakman Company.
ss. T & S Brass and Bronze Works, Inc.
tt. Water Management, Inc.
uu. Wolverine Brass, Inc.
vv. Zurn Plumbing Products Group; Commercial Brass Operation.
ww. Not used.
xx. American Standard Companies, Inc.
yy. Bradley Corporation.
zz. Brasstech Inc.; Newport Brass Div.
aaa. Central Brass Manufacturing Company.
bbb. Chicago Faucets.
ccc. Delta Faucet Company.
ddd. Eljer.
eee. Elkay Manufacturing Co.
fff. Fisher Manufacturing Co.
ggg. Franke Consumer Products, Inc.; Kitchen Systems Div.
hhh. Gerber Plumbing Fixtures LLC.
iii. Grohe America, Inc.
jjj. Hansgrohe Inc.
kkk. Hydrotek International, Inc.
lll. Intersan Manufacturing Company.
mmm. Just Manufacturing Company.
nnn. Kohler Co.
ooo. Moen, Inc.
ppp. Paul Decorative Products.
qqq. Pegler, Ltd.

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- rrr. Phoenix Products, Inc.
 - sss. Price Pfister, Inc.
 - ttt. Rohl LLC.
 - uuu. Royal Brass Mfg. Co.
 - vvv. Sayco; a Briggs Plumbing Products, Inc. Company.
 - www. Sterling Plumbing Group, Inc.
 - xxx. St. Thomas Creations.
 - yyy. Speakman Company.
 - zzz. Symmons Industries, Inc.
 - aaaa. T & S Brass and Bronze Works, Inc.
 - bbbb. Water Management, Inc.
 - cccc. WhiteRock Corp.
 - dddd. Wolverine Brass, Inc.
 - eeee. Zurn Plumbing Products Group; Commercial Brass Operation.
 - ffff. Not used.
 - gggg. American Standard Companies, Inc.
 - hhhh. Delta Faucet Company.
 - iiii. Eljer.
 - jjjj. Moen, Inc.
 - kkkk. Phoenix Products, Inc.
 - llll. Sayco; a Briggs Plumbing Products, Inc. Company.
 - mmmm. Sterling Plumbing Group, Inc.
 - nnnn. WhiteRock Corp.
 - oooo. Wolverine Brass, Inc.
 - pppp. Not used.
 - qqqq. Gerber Plumbing Fixtures LLC.
 - rrrr. Sterling Plumbing Group, Inc.
 - ssss. Zurn Plumbing Products Group; Wilkins Operation.
 - tttt. Not used.
4. Description: Kitchen faucet with spray, three-hole fixture. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
- a. Body Material: Residential, nonmetallic underbody with nonmetallic cover plate
 - b. Finish: Nonmetallic.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Backflow Protection Device for Hose Outlet: Not required.
 - f. Backflow Protection Device for Side Spray: Not required.
 - g. Centers: 3-3/8 inches Single hole.
 - h. Mounting: Deck.
 - i. Handle(s): Lever.
 - j. Inlet(s): NPS 3/8.
 - k. Spout Type: Swivel gooseneck.
 - l. Spout Outlet: Spray.
 - m. Vacuum Breaker: Required.
 - n. Operation: Noncompression, manual.
 - o. Drain: Stopper with chain.

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2.6 FLUSHOMETERS

A. Flushometers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Coyne & Delany Co.
 - b. Delta Faucet Company.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group; Commercial Brass Operation.
 - e. Not used.
 - f. Hydrotek International, Inc.
 - g. Sloan Valve Company.
 - h. TOTO USA, Inc.
 - i. Not used.
 - j. Coyne & Delany Co.
 - k. Delta Faucet Company.
 - l. Hydrotek International, Inc.
 - m. Sloan Valve Company.
 - n. TOTO USA, Inc.
 - o. Zurn Plumbing Products Group; Commercial Brass Operation.
 - p. Not used.
4. Description: Flushometer for urinal, water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.
 - b. Style: Concealed.
 - c. Inlet Size: NPS 3/4.
 - d. Trip Mechanism: Oscillating, lever-handle actuator.
 - e. Consumption: 1.6 gal./flush.
 - f. Tailpiece Size: NPS 3/4 length to top of bowl.

2.7 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Centoco Manufacturing Corp.

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- d. Church Seats.
 - e. Eljer.
 - f. Kohler Co.
 - g. Olsonite Corp.
 - h. Sanderson Plumbing Products, Inc.; Beneke Div.
 - i. Sperzel.
 - j. Not used.
 - k. Bemis Manufacturing Company.
 - l. Centoco Manufacturing Corp.
 - m. Church Seats.
 - n. Kohler Co.
 - o. Olsonite Corp.
 - p. Pressalit A/S.
 - q. Sanderson Plumbing Products, Inc.; Beneke Div.
 - r. Sperzel.
 - s. Not used.
4. Description: Toilet seat for water-closet-type fixture.
- a. Material: Molded, solid plastic **with antimicrobial agent**.
 - b. Configuration: **Open** front **with** cover.
 - c. Size: Elongated.
 - d. Hinge Type: **CK, check**.
 - e. Class: Standard commercial.
 - f. Color: **White**.

2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
- 3. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.9 FIXTURE SUPPORTS

- ### A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Water-Closet Supports:
1. Description: Combination carrier designed for accessible mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- D. Urinal Supports:
1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Lavatory Supports:
1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- F. Sink Supports:
1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.10 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B & K Industries, Inc.
 - b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
 - c. Brasstech Inc.; Newport Brass Div.
 - d. Dearborn Brass; a div. of Moen, Inc.
 - e. Geberit Manufacturing, Inc.
 - f. JB Products; a Federal Process Corporation Company.
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Watts Brass & Tubular; a division of Watts Regulator Co.
 3. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet

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pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch-ID inlet and 7/8-inch-ID outlet hose connections.

4. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.11 DISPOSERS

A. Disposers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - c. In-Sink-Erator; a div. of Emerson Electric Co.
 - d. KitchenAid.
 - e. Maytag Co.
 - f. Not used.
 - g. American Standard Companies, Inc.
 - h. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.
 - i. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - j. In-Sink-Erator; a div. of Emerson Electric Co.
 - k. KitchenAid.
 - l. Maytag Co.
 - m. WhiteRock Corp.
 - n. Not used.
4. Description: Batch-feed household, food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
 - a. Type: Batch-feed household.
 - b. Model: Not applicable.
 - c. Motor: 115-V ac, 1725 rpm, **1/2** hp with overload protection.

2.12 HOT-WATER DISPENSERS

A. Hot-Water Dispensers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.

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- b. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - c. In-Sink-Erator; a div. of Emerson Electric Co.
 - d. Just Manufacturing Company.
 - e. Not used.
 - f. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.
 - g. Elkay Manufacturing Co.
 - h. In-Sink-Erator; a div. of Emerson Electric Co.
 - i. Just Manufacturing Company.
 - j. KitchenAid.
 - k. Not used.
4. Description: Gooseneck spout with lever-handle, flow control, household-type dispenser with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric heating element; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F; and thermal-overload protection.
- a. Storage Tank Capacity: 0.5 gal.
 - b. Heating Element: 750 W minimum, 115-V ac.

2.13 WATER CLOSETS

A. Water Closets:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Barclay Products, Ltd.
 - c. Briggs Plumbing Products, Inc.
 - d. Crane Plumbing, L.L.C./Fiat Products.
 - e. Duravit USA, Inc.
 - f. Eljer.
 - g. Gerber Plumbing Fixtures LLC.
 - h. Kohler Co.
 - i. Mansfield Plumbing Products, Inc.
 - j. Peerless Pottery, Inc.
 - k. Sanitarios Azteca, S.A. de C.V.
 - l. Sterling Plumbing Group, Inc.
 - m. St. Thomas Creations.
 - n. TOTO USA, Inc.
 - o. Water Management, Inc.
 - p. Not used.
 - q. Capizzi.
 - r. St. Thomas Creations.
 - s. Not used.
 - t. American Standard Companies, Inc.
 - u. Gerber Plumbing Fixtures LLC.
 - v. Kohler Co.

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- w. Mansfield Plumbing Products, Inc.
 - x. St. Thomas Creations.
 - y. Not used.
 - z. Crane Plumbing, L.L.C./Fiat Products.
 - aa. Eljer.
 - bb. Peerless Pottery, Inc.
 - cc. Water Management, Inc.
 - dd. Not used.
 - ee. Briggs Plumbing Products, Inc.
 - ff. Not used.
 - gg. American Standard Companies, Inc.
 - hh. Briggs Plumbing Products, Inc.
 - ii. Capizzi.
 - jj. Crane Plumbing, L.L.C./Fiat Products.
 - kk. Eljer.
 - ll. Kohler Co.
 - mm. Mansfield Plumbing Products, Inc.
 - nn. Peerless Pottery, Inc.
 - oo. Sanitarios Azteca, S.A. de C.V.
 - pp. St. Thomas Creations.
 - qq. TOTO USA, Inc.
 - rr. Not used.
4. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for gravity-type tank operation.
5. Style: Close coupled.
- a. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - b. Height: Accessible.
 - c. Design Consumption: 1 gal./flush.
 - d. Tank: Gravity type with trim. Include cover.
 - e. Trip Mechanism: Lever-handle actuator.
 - f. Color: White.
6. Supply: NPS 3/8 chrome-plated brass or copper with wheel-handle stop.
7. Style: Flushometer valve.
- a. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - b. Height: Accessible.
 - c. Design Consumption: 1.6 gal./flush.
 - d. Color: White.

2.14 URINALS

A. Urinals:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.

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- c. Capizzi.
 - d. Crane Plumbing, L.L.C./Fiat Products.
 - e. Duravit USA, Inc.
 - f. Eljer.
 - g. Kohler Co.
 - h. Mansfield Plumbing Products, Inc.
 - i. Peerless Pottery, Inc.
 - j. Sanitarios Azteca, S.A. de C.V.
 - k. St. Thomas Creations.
 - l. TOTO USA, Inc.
 - m. Not used.
4. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
- a. Type: Blowout.
 - b. Strainer or Trapway: Integral cast strainer with integral trap.
 - c. Design Consumption: 0.5 gal./flush.
 - d. Color: White.
 - e. Supply Spud Size: NPS 3/4.
 - f. Outlet Size: NPS 1-1/2.

2.15 LAVATORIES

A. Lavatories:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Eljer.
 - d. Kohler Co.
 - e. Not used.
 - f. American Standard Companies, Inc.
 - g. Barclay Products, Ltd.
 - h. Briggs Plumbing Products, Inc.
 - i. Crane Plumbing, L.L.C./Fiat Products.
 - j. Eljer.
 - k. Gerber Plumbing Fixtures LLC.
 - l. Kohler Co.
 - m. Mansfield Plumbing Products, Inc.
 - n. Peerless Pottery, Inc.
 - o. Sterling Plumbing Group, Inc.
 - p. St. Thomas Creations.
 - q. TOTO USA, Inc.
 - r. Not used.
- 4. Description: Accessible, wall fixture.
 - a. Type: With back.

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- b. Size: 18 by 15 inches rectangular.
- c. Faucet Hole Punching: One hole.
- d. Faucet Hole Location: Top.
- e. Pedestal: Not required.
- f. Color: White.
- g. Faucet: Lavatory for separate drain.
- h. Supplies: NPS 3/8 chrome-plated copper with stops.
- i. Drain: See faucet.
 - 1) Location: Not applicable.
- j. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4 thick tubular brass waste to wall; and wall escutcheon.
- k. Drain Piping: Schedule 40 ABS, NPS 1-1/4, tubular waste to wall; and wall escutcheon.
 - 1) Exception: Omit P-trap if hair interceptor is required.
- l. Hair Interceptor: Not required.
- m. Fixture Support: Lavatory.

2.16 BATHTUBS

A. Bathtubs:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Eljer.
 - b. Jacuzzi, Inc.
 - c. Kohler Co.
 - d. Not used.
 - e. American Standard Companies, Inc.
 - f. Bootz Plumbingware Co.
 - g. Briggs Plumbing Products, Inc.
 - h. Crane Plumbing, L.L.C./Fiat Products.
 - i. Mansfield Plumbing Products, Inc.
 - j. Not used.
 - k.
 - l. Aker Plastics Co., Inc.
 - m. Best Bath Systems; a div. of Fiberglass Systems, Inc.
 - n. Clarion Bathware.
 - o. Florestone Products Co., Inc.
 - p. Praxis Industries, Inc.; Aquarius Products.
 - q. Sterling Plumbing Group, Inc.
 - r. Swan Corporation (The).
 - s. Not used.
 - t. Acryline USA, Inc.
 - u. American Standard Companies, Inc.
 - v. Aqua Bath Company, Inc.
 - w. Aqua Glass Corporation.

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- x. Aquatic Industries, Inc.
 - y. Best Bath Systems; a div. of Fiberglass Systems, Inc.
 - z. Clarion Bathware.
 - aa. Crane Plumbing, L.L.C./Fiat Products.
 - bb. Florestone Products Co., Inc.
 - cc. Kohler Co.
 - dd. Lyons Industries, Inc.
 - ee. Mansfield Plumbing Products, Inc.; Acrylic Operations.
 - ff. Praxis Industries, Inc.; Aquarius Products.
 - gg. St. Thomas Creations.
 - hh. Swan Corporation (The).
 - ii. Not used.
4. Description: Enameled, cast-iron fixture.
- a. Bathing Surface: Slip resistant.
 - b. Size: 48 by 30 inches with front apron.
 - c. Color: White.
 - d. Drain Location: Left end.
 - e. Accessibility Options: Include grab bar and bench.
 - f. Faucet: Bathtub/shower.
 - g. Supplies: NPS 1/2 copper tubing with ball, gate, or globe valves.
 - h. Drain: NPS 1-1/2; chrome-plated exposed parts; brass pop-up waste and overflow.
 - i. Drain Piping: NPS 1-1/2 cast-brass P-trap and waste.
 - j. Drain Piping: Schedule 40 ABS or PVC, NPS 1-1/2 P-trap and waste.

2.17 INDIVIDUAL SHOWERS

A. Individual Showers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Aker Plastics Co., Inc.
 - b. Aqua Glass Corporation.
 - c. Clarion Bathware.
 - d. Florestone Products Co., Inc.
 - e. LASCO Bathware.
 - f. Praxis Industries, Inc.; Aquarius Products.
 - g. Sterling Plumbing Group, Inc.
 - h. Swan Corporation (The).
 - i. Not used.
 - j. Acryline USA, Inc.
 - k. Aker Plastics Co., Inc.
 - l. Aqua Bath Company, Inc.
 - m. Aqua Glass Corporation.
 - n. Aquatic Industries, Inc.
 - o. Clarion Bathware.
 - p. Crane Plumbing, L.L.C./Fiat Products.

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- q. Jacuzzi, Inc.
 - r. Kohler Co.
 - s. LASCO Bathware.
 - t. Praxis Industries, Inc.; Aquarius Products.
 - u. Not used.
4. Description: Accessible shower enclosure with slip-resistant bathing surface and shower rod with curtain.
- a. Size: 36 by 34 inches.
 - b. Surround: One piece .
 - c. Surround: One piece.
 - d. Color: White.
 - e. Drain Location: Left side.
 - f. Accessibility Options: Include grab bar and bench.
 - g. Faucet: Shower.
 - h. Drain: Grid, NPS 2.

2.18 KITCHEN SINKS

A. Kitchen Sinks:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Commercial Enameling Company.
 - b. Eljer.
 - c. Jacuzzi, Inc.
 - d. Kohler Co.
 - e. Not used.
 - f. Gerber Plumbing Fixtures LLC.
 - g. Lyons Industries, Inc.
 - h. Not used.
 - i. American Standard Companies, Inc.
 - j. Bootz Plumbingware Co.
 - k. Briggs Plumbing Products, Inc.
 - l. Eljer.
 - m. Mansfield Plumbing Products, Inc.
 - n. Not used.
 - o. Avonite, Inc.
 - p. DuPont, Corian Products.
 - q. FHP Kindred USA.
 - r. Formica Corporation.
 - s. Franke Consumer Products, Inc., Kitchen Systems Div.
 - t. Lippert Corporation.
 - u. Rynone Manufacturing Corp.
 - v. Swan Corporation (The).
 - w. Wilsonart International.
 - x. Not used.

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- y. Dayton Products, Inc.
 - z. Elkay Manufacturing Co.
 - aa. Franke Consumer Products, Inc., Kitchen Systems Div.
 - bb. Just Manufacturing Company.
 - cc. Kohler Co.
 - dd. Moen, Inc.
 - ee. Revere Sink.
 - ff. Sterling Plumbing Group, Inc.
 - gg. Teka USA.
 - hh. WhiteRock Corp.
 - ii. Not used.
4. Description: Two-bowl, residential, counter-mounting, porcelain-enameled, formed-steel kitchen sink.
- a. Overall Dimensions: Refer to plan.
 - b. Metal Thickness: 0.050 inch.
 - c. Bowl:
 - 1) Dimensions: Refer to plan.
 - 2) Drain: 3-1/2-inch outlet for disposer.
 - a) Location: Centered in bowl.
 - d. Left Bowl:
 - 1) Dimensions: Refer to plan.
 - 2) Drain: 3-1/2-inch outlet for disposer.
 - a) Location: Centered in bowl.
 - e. Right Bowl:
 - 1) Dimensions: Refer to plan.
 - 2) Drain: 3-1/2-inch grid with offset waste.
 - a) Location: Centered in bowl.

2.19 SERVICE SINKS

A. Service Sinks:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Eljer.
 - d. Kohler Co.
 - e. Not used.
 - f. Crane Plumbing, L.L.C./Fiat Products.
 - g. Eljer.
 - h. Kohler Co.
 - i. Not used.
- 4. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim back and rim guard on front and sides.
 - a. Size: 24 by 20 inches.

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- b. Size: 22 by 20 inches.
- c. Color: White.
- d. Faucet: Sink.
- e. Drain: Grid with NPS 2 outlet.
- f. Trap Standard: NPS 2 enameled, cast iron with cleanout and floor flange.
- g. Fixture Support: Sink.

2.20 LAUNDRY TRAYS

A. Laundry Trays:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Commercial Enameling Company.
 - b. Eljer.
 - c. Not used.
 - d. Crane Plumbing, L.L.C./Fiat Products.
 - e. Florestone Products Co., Inc.
 - f. Gerber Plumbing Fixtures LLC.
 - g. Mustee, E. L. & Sons, Inc.
 - h. Swan Corporation (The).
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Not used.
4. Description: Stand-mounting, plastic laundry trays.
 - a. Size: 24 by 21 inches.
 - b. Color: Not applicable.
 - c. Faucet: Sink for wall mounting.
 - d. Supplies: NPS 1/2 chrome-plated copper with stops.
 - e. Drain: Grid with NPS 1-1/2 outlet.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch-thick tubular brass waste to wall; and wall escutcheon.
 - g. Drain Piping: Schedule 40 ABS, NPS 1-1/2 P-trap; tubular waste to wall; and wall escutcheon.
 - h. Stand: Not required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

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2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- S. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.

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- T. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- U. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- V. Set bathtubs and showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.

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- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.

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- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

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- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

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1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 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. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. 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.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

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- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

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7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

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2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.

1.2 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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 unavailable, 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

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1. Basic Wind Speed:
2. Building Classification Category: [I] [II] [III] [IV].
3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
 - a. Component Importance Factor: [1.0] [1.5]
 - b. Component Response Modification Factor: [1.5] [2.5] [3.5] [5.0]
 - c. Component Amplification Factor: [1.0] [2.5]
3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
4. Design Spectral Response Acceleration at 1.0-Second Period:

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.

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- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with [threaded mounting holes] [elastomeric pad].
 - c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

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2.15 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized, steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- C. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- D. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

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- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 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 at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black
3. Background Color: White
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

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1. 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.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Blue.
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

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3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."
- B. Pipe Label Locations: 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:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Refrigerant Piping: Black letters on a safety-orange background.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue For cold-air supply ducts.
 - 2. Yellow For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

- a. Constant-volume air systems.
- b. Variable-air-volume systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by [AABC, NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

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- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Duct systems are complete with terminals installed.
 - b. Volume, smoke, and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. Fans are operating, free of vibration, and rotating in correct direction.
 - e. Variable-frequency controllers' startup is complete and 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.
 - 2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.

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- i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete and safeties are verified.
- k. 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", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- 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 manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- 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. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

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 artificial loading of filters at the time static pressures are measured.
 - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Architect, Owner, and Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. 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 occurs. 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.

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2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain 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 inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.

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 two-thirds 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 set point 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. 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 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.

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- 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 that 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 set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
- 9. Verify final system conditions as follows:
 - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
 - d. Mark 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 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

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1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.8 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 2. Air Outlets and Inlets: Plus or minus 5 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.9 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.

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10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:

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- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch (mm) o.c.
 - f. Make and model number.
 - g. Face area in sq. ft. (sq. m).
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).

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- l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - d. Air temperature differential in deg F (deg C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F (deg C).
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.

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- d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm (L/s).
 - i. Face area in sq. ft. (sq. m).
 - j. Minimum face velocity in fpm (m/s).
2. Test Data (Indicated and Actual Values):
- a. Heat output in Btu/h (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

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1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports:

1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft. (sq. m).
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).

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- b. Entering-water temperature in deg F (deg C).
 - c. Leaving-water temperature in deg F (deg C).
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F (deg C).
 - f. Leaving-air temperature in deg F (deg C).
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches (mm).
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches (mm).
 - d. Full-open flow rate in gpm (L/s).
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm (L/s).
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- N. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

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3.10 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, **[Owner]** **[design professional]** **[Architect]** may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Body and Bonnet: Forged brass or cast bronze.

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3. Packing: Molded stem, back seating, and replaceable under pressure.
 4. Operator: Rising stem.
 5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 6. Seal Cap: Forged-brass or valox hex cap.
 7. End Connections: Socket, union, threaded, or flanged.
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig (3450 kPa).
- E. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 275 deg F (135 deg C).
- F. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa).
 6. Maximum Operating Temperature: 275 deg F (135 deg C).
- G. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in parts per million (ppm).
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).

2.4 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

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- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. 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.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or

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panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. 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. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. 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.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.

2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod, 3/8 inch (9.5 mm).
 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.

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- b. System shall maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

- 1. Install core in filter dryers after leak test but before evacuation.
- 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
- 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
- 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural

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Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for

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static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60 (Z180)
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches (102 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

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6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

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1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

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- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. 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 a maximum intervals of 16 feet (5 m).
- F. 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.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 2. Brace a change of direction longer than 12 feet (3.7 m).
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

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- B. Use service openings for entry and inspection.
1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide drainage and cleanup for wash-down procedures.
 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

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3.9 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, stainless steel.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 1-inch wg (250 Pa)
- b. Minimum SMACNA Seal Class: A
- c. SMACNA Leakage Class for Rectangular: 12
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units

- a. Pressure Class: Positive 2-inch wg (500 Pa)
- b. Minimum SMACNA Seal Class: A
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

- C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
- b. Minimum SMACNA Seal Class: A
- c. SMACNA Leakage Class for Rectangular: 12
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units

- a. Pressure Class: Positive or negative 2-inch wg (500 Pa)
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

- D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

- a. Pressure Class: Negative 1-inch wg (250 Pa).
- b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Rectangular: 12
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

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E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive or negative 1-inch wg (250 Pa)
- b. Minimum SMACNA Seal Class: A
- c. SMACNA Leakage Class for Rectangular: 12
- d. SMACNA Leakage Class for Round and Flat Oval: 6

2. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
- b. Minimum SMACNA Seal Class: A
- c. SMACNA Leakage Class for Rectangular: 6
- d. SMACNA Leakage Class for Round and Flat Oval: 3

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. PVC-Coated Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

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- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Requirements:

1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
3. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Maximum Air Velocity: 1250 fpm (6.4 m/s)
- C. Maximum System Pressure: 1-inch wg (0.25 kPa)
- D. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached[and mounting flange.
- E. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Neoprene, mechanically locked.
- H. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch (5 mm).
- I. Tie Bars and Brackets: Galvanized steel.
- J. Return Spring: Adjustable tension.

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K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
 - b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: [Galvanized steel] [Aluminum].
8. Screen Type: [Bird] [Insect].
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

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4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
 5. Blade Axles: Galvanized steel.
 6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 7. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 0.5-inch (13-mm) diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

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- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 8. Upstream[and downstream] from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

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- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with adhesive.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

- 1. Operate dampers to verify full range of movement.
- 2. Inspect locations of access doors and verify that purpose of access door can be performed.
- 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
- 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233413 - AXIAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tubeaxial fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.
7. Fan speed controllers.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For axial fans to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: One set(s) for each belt-driven unit.

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PART 2 - PRODUCTS

2.1 TUBEAXIAL FANS

- A. Description: Fan wheel and housing, factory-mounted motor with belt or direct drive, an inlet cone section, and accessories.
- B. Housings: Aluminum with flanged inlet and outlet connections.
- C. Wheel Assemblies: Cast or extruded aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
- D. Wheel Assemblies: Cast aluminum, machined and fitted to shaft.
- E. Belt Drives:
 - 1. Factory mounted, with adjustable alignment and belt tensioning.
 - 2. Service Factor Based on Fan Motor Size: 1.2.
 - 3. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
 - 4. Fan Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 - 5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
 - 8. Motor Mount: Adjustable base.
 - 9. Shaft Bearings: Radial, self-aligning bearings.
- F. Accessories:
 - 1. Companion Flanges: Rolled flanges of same material as housing.
 - 2. Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.
 - 3. Propeller Access Section Door: Short duct section bolted to fan inlet and outlet allowing access to internal parts of fan for inspection and cleaning, of same material as housing.
 - 4. Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.
 - 5. Mounting Clips: Horizontal ceiling clips welded to fan housing, of same material as housing.
 - 6. Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.
 - 7. Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.
 - 8. Inlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
 - 9. Outlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
 - 10. Backdraft Dampers: Butterfly style, for bolting to the discharge of fan or outlet cone, of same material as housing.

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11. Shaft Seal: Elastomeric seal and Teflon wear plate, suitable for up to 300 deg F (149 deg C).
12. Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.
13. Inlet Vanes: Adjustable; with peripheral control linkage operated from outside of airstream, bronze sleeve bearings on each end of vane support, and provision for manual or automatic operation of same material as housing.
14. Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.
15. Inlet Cone: Round-to-round transition of same material as housing.
16. Outlet Cone: Round-to-round transition, of same material as housing.
17. Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.
18. Direct-Driven Units: Encase motor in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing. Extend lubrication lines to outside of casing and terminate with grease fittings.

G. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.
3. Coatings: Thermoplastic vinyl
 - a. Apply to finished housings.
 - b. Apply to fan wheels.

2.2 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install axial fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
1. Install fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

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3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

- E. Install units with clearances for service and maintenance.
- F. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 233413

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Devices shall be specifically designed for variable-air-volume flows.
- B. Material: Aluminum.
- C. Finish: Baked enamel, color selected by Architect.
- D. Face Size: 12 by 12 inches (300 by 300 mm).
- E. Face Style: Three cone.
- F. Mounting: Surface.
- G. Pattern: Adjustable.
- H. Dampers: Radial opposed blade.
- I. Accessories:
 1. Equalizing grid.

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2. Plaster ring.
3. Safety chain.
4. Wire guard.
5. Sectorizing baffles.
6. Operating rod extension.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 236313 - AIR-COOLED REFRIGERANT CONDENSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, air-cooled refrigerant condensers for outdoor installation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Trane-Mitsubishi or equivalent

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.
- B. Refrigerant: R-410A.
- C. Refrigerant: R-407C or R-410A.
- D. Condenser Coil: Factory tested at 425 psig (2930 kPa).
 - 1. Tube: 1/2-inch- (13-mm-) diameter seamless copper.
 - 2. Coil Fin: Aluminum.

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3. Coating: Thermoplastic vinyl.
 4. Circuit: To match compressors with liquid subcooling coil.
- E. Condenser Fans and Drives: Propeller fans with aluminum or galvanized-steel fan blades, for horizontal air discharge; directly driven with permanently lubricated ball-bearing motors with integral current- and thermal-overload protection.
1. Weather-proof motors with rain shield and shaft slinger.
 2. Extend grease lines to outside of casing.
- F. Condenser Fans and Drives: Forward-curved centrifugal fans for horizontal air discharge.
1. Fan on steel shaft with self-aligning ball bearings.
 2. V-belt drive with minimum of two belts; variable pitch drive pulley.
 3. Motor mounted on adjustable slide base.
- G. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.
1. Fan Cycling Control: Ambient thermostats.
- H. Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for outdoor installation with weather protection for components and controls, and with the following:
1. Removable panels for access to controls, condenser fans, motors, and drives.
 2. Plated-steel fan guards.
 3. Lifting eyes.
 4. Removable legs, 20 inches (500 mm) high.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.
 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 3. Mount unit-mounted disconnect switches on exterior of unit.

2.4 SOURCE QUALITY CONTROL

- A. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Equipment Mounting:
 - 1. Install air-cooled condenser refrigerant condensers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform electrical test and visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Complete manufacturer's starting checklist.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.

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- C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- D. Air-cooled refrigerant condensers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 236313

SECTION 238123.13 - COMPUTER-ROOM AIR-CONDITIONERS, CEILING-MOUNTED UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ceiling-mounted, computer-room air conditioners.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from installers of the items involved.
- B. Seismic Qualification Certificates: For computer-room air conditioners, accessories, and components, from manufacturer.
- C. Field quality-control reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Computer-room air-conditioners, ceiling-mounted units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

2.2 MANUFACTURED UNITS

- A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls.
 - 1. Mounting Configuration: Exposed in the space.
 - 2. Mounting Configuration: Fit T-bar in lay-in ceiling opening.
 - 3. Mounting Configuration: Concealed above a hard ceiling.
- B. Cabinet: Galvanized steel serviceable from one side, with baked-enamel finish, insulated with 1/2-inch- (13-mm-) thick duct liner, and mounting bracket attached to the unit.
 - 1. Integral factory-supplied supply and return grille to fit ceiling grid kit of 24 by 48 inches (610 by 1220 mm), with filter.
 - 2. Unit with supply and return collars for ducting in the field.
 - 3. Unit with 24-by-48-inch (610-by-1220-mm) air distribution plenum, with integral MERV 8 filter and three-way air distribution.
 - 4. Unit with two-speed, centrifugal direct-drive fan.
 - 5. Unit with single-speed, centrifugal belt-driven fan.
 - 6. Unit with high static blower assembly consisting of field-attached blower box with double-inlet, centrifugal belt-driven fan; with single-speed motor mounted on an adjustable base, and providing up to 2 inches wc (500 Pa) of external pressure.

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7. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Supply-Air Fan:
1. Forward curved, double width, double inlet, centrifugal, with adjustable V-belt drive.
 2. Plug/plenum, single inlet, direct drive, electronically commutated, and variable speed.
- D. Refrigeration System:
1. Compressor: Scroll, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
 2. Refrigeration Circuit Components:
 - a. Low-pressure switch.
 - b. Manually reset, high-pressure switch.
 - c. Thermal-expansion valve with external equalizer.
 - d. Sight glass with moisture indicator.
 - e. Service shutoff valves.
 - f. Charging valves.
 - g. Hot-gas bypass.
 - h. Refrigerant charge.
 3. Refrigerant: R-410A.
 4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
 5. Refrigerant line sets precharged in lengths of 15 feet (4.6 m) and of sufficient length to serve the unit from its condensing unit.
 6. Refrigerant line-sweat-adapter kit to permit field brazing of refrigerant lines.
 - a. Mount stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir under coil assembly.
 7. Remote, Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with direct-drive, centrifugal fan.
 8. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
 9. Mount stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir under coil assembly.
- E. Electric-Resistance Reheat Coil:
1. Finned-tube electric elements with contactor.
 2. Dehumidification relay.
 3. High-temperature-limit switches.
 4. SCR to proportionally control the reheat elements providing precise temperature control.
- F. Filter: 1-inch- (25-mm-) thick, disposable, glass-fiber media.

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1. Initial Resistance:
 2. Recommended Final Resistance:
 3. Arrestance: 90 percent, according to ASHRAE 52.2.
 4. MERV: 13 according to ASHRAE 52.2.
- G. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.
1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.
 2. Control: Fully modulating to provide gradual modulation from zero to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
 3. Drain Cycle: Field-adjustable drain duration and drain interval.
- H. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- I. Single point power kit permitting single electrical feed to the evaporator and condensing unit of a close-coupled system.
- J. Epoxy-coated, step-down transformer suitable for mounting on the outdoor condensing unit to provide it with 277-V input power.
- K. Control System:
1. Microprocessor unit-mounted panel.
 2. Fan contactor.
 3. Compressor contactor.
 4. Compressor start capacitor.
 5. Control transformer with circuit breaker.
 6. Solid-state temperature control modules.
 7. Humidity contactor.
 8. Time-delay relay.
 9. Heating contactor.
 10. Smoke sensor.
 11. Filter clog switch.
 12. Alarm contacts.
 13. High-temperature thermostat.
 14. Solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.
 15. Remote panel to monitor and change temperature and humidity set points and sensitivities of the unit and unit alarms.
- L. Fan Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

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- a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.
- b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Install computer-room air conditioners coordinated with computer-room access flooring Installer.
- C. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.
- D. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and elastomeric hangers of size required to support weight of computer-room air conditioner.
 1. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC." Fabricate brackets or supports as required.
 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- E. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads on concrete base. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 1. Minimum Deflection: 1/4 inch (6 mm).

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

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3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. After startup service and performance test, change filters and flush humidifier.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123.13

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:

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- a. For Compressor: One year(s) from date of Substantial Completion.
- b. For Parts: One year(s) from date of Substantial Completion.
- c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; with a two-position control valve.
5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
9. Filters: Permanent, cleanable.
10. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2 inches (50 mm) deep.
 - b. Single-wall, galvanized-steel sheet.
 - c. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

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- d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1 (DN 25).
- e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
- f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.2 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- 4. Fan: Aluminum-propeller type, directly connected to motor.
- 5. Motor: Permanently lubricated, with integral thermal-overload protection.
- 6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
- 7. Mounting Base: Polyethylene.

2.3 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection including auto setting.

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- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- F. Drain Hose: For condensate.
- G. Additional Monitoring:
 - 1. Monitor constant and variable motor loads.
 - 2. Monitor variable-frequency-drive operation.
 - 3. Monitor economizer cycle.
 - 4. Monitor cooling load.
 - 5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 - 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

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1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ductless fan coil units and accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale and coordinated with each other based on input from installers of the items involved:
- B. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.
- C. Field quality-control reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTLESS FAN COIL UNITS

- A. Fan Coil Unit Configurations: Row split.
 - 1. Number of Heating Coils: One with two-pipe system.
 - 2. Number of Cooling Coils: One with two-pipe system.
- B. Coil Section Insulation: 1/2-inch- (13-mm-) thick, coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Coil Section Insulation: Insulate coil section according to Section 230616 "HVAC Equipment Insulation."
 - 1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Main and Auxiliary Drain Pans: Plastic. Fabricate pans and drain connections to comply with ASHRAE 62.1. Drain pans shall be removable.
- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel. Floor-mounting units shall have leveling screws.
- F. Cabinet: Steel with factory prime coating, ready for field painting.
 - 1. Vertical Unit Front Panels: Removable, steel, with integral stamped discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
 - 2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped discharge grilles.
 - 3. Stack Unit Discharge and Return Grille: Aluminum double-deflection discharge grille, and louvered- or panel-type return grille; color as selected by Architect from manufacturer's standard colors. Return grille shall provide maintenance access to fan coil unit.

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4. Steel recessing flanges for recessing fan coil units into ceiling or wall.
- G. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.
1. MERV Rating: 13 when tested according to ASHRAE 52.2.
- H. Fan and Motor Board: Removable.
1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- I. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- J. Basic Unit Controls:
1. Control voltage transformer.
 2. Wall-mounting thermostat with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Manual changeover.
 - e. Adjustable deadband.
 - f. Exposed set point.
 - g. Exposed indication.
 - h. Degree F indication.
 3. Unit-mounted humidistat.
 - a. Concealed set point.
 - b. Concealed indication.
 4. Wall-mounting temperature sensor.
 5. Unoccupied-period-override push button.
 6. Data entry and access port.
 - a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
 - b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.
- K. DDC Terminal Controller:

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1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
 2. Unoccupied-Period-Override Operation: Two hours.
 3. Unit Supply-Air Fan Operation:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain room setback temperature.
 4. Controller shall have volatile-memory backup.
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan coil units level and plumb.
- B. Install fan coil units to comply with NFPA 90A.
- C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above finished floor.
- E. Install new filters in each fan coil unit within two weeks after Substantial Completion.
- F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 1. Install piping adjacent to machine to allow service and maintenance.
 2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
 3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.3 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 238219

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 2000 V and less.
2. Connectors, splices, and terminations rated 2000 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in VFC circuits.

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- D. Conductors: Copper complying with NEMA WC 70/ICEA S-95-658.
 - 1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2.
 - 2. PV Conductor Insulation: Comply with UL 4703.
- E. Cable: Comply with NEMA WC 70/ICEA S-95-658 for nonmetallic-sheathed cable, Type NM with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- F. NFPA 70 restricts use of exposed Type NM cable in some types of construction. See NFPA 70, Article 334, for complete listing of restrictions.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

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- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.4 CONNECTIONS

- A. 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

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3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. ATS
 - b. Emergency panel EM2 conductors
 - c. Conductor to new backup LP Generator
 - 2. Perform each of the following visual and electrical tests:
 - a. Compare conductor and cable data with Drawings and Specifications.
 - b. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - c. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - d. Inspect compression applied connectors for correct cable match and indentation.
 - e. Inspect for correct identification.
 - f. Inspect cable jacket and condition.
 - g. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - h. Continuity test on each conductor and cable.

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- i. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 1. Structural members in paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.

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- C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: sheet metal.
 - 2. Type: Fully adjustable
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes:
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
 - 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

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- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Gangable boxes are allowed.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
 - 1. NEMA 250, Type 1, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Standard: Comply with SCTE 77.
 - 2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC."
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
 - 1. Standard: Comply with SCTE 77.

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2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC, EMT.
3. Underground Conduit: RNC, Type EPC-80-PVC or concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: **3/4-inch (21-mm)** trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after

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- installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F (49 deg C)**.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches ((300 mm)) of enclosures to which attached.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:

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1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
1. Install surface raceway with a minimum 2-inch ((50-mm))radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).

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2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Z. Set metal floor boxes level and flush with finished floor surface.
- AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

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3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1[**and IEEE C2**].
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.

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- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 LABELS

- A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Self-Adhesive Labels:
 - 1. Preprinted 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 2. Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
 - a. Nominal Size: 3.5-by-5-inch (76-by-127-mm).

2.5 TAPES AND STENCILS:

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

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- C. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
- D. Underground-Line Warning Tape
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

2.6 Tags

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, [0.015 inch (0.38 mm)] [0.023 inch (0.58 mm)] thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- C. Write-On Tags:
 - 1. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to raceway, conductor, or cable.
 - 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black, except where used for color-coding.

- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 - 5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- D. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- E. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- F. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

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3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use industry standard colors for ungrounded feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive, self-laminating polyester labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

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1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- K. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
1. Comply with NFPA 70E and ANSI Z535.4.
 2. Comply with Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
1. Labeling Instructions:

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- a. Indoor Equipment: Self-adhesive. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- b. Outdoor Equipment: laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. outdoor motion sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST .
3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule.
5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
7. Astronomic Time: All channels.
8. Automatic daylight savings time changeover.
9. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

B. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.

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3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
5. Astronomic time dial.
6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
7. Skip-a-day mode.
8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 > hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Thirty-second minimum, to prevent false operation.
 4. Lightning Arrester: Air-gap type.
 5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.3 OUTDOOR MOTION SENSORS

- A. General Requirements for Sensors: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application and shall comply with California Title 24.
 2. PIR type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
 3. Switch Rating:
 - a. Lighting-Fixture-Mounted Sensor: if integrated within fixture, may be used in lieu of external device or fixture mounted sensor.
 - b. Separately Mounted Sensor: 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. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 4. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off." With bypass switch to override the "on" function in case of sensor failure.
 5. Voltage: Match the circuit voltage type.
 6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
 - b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.

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7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

2.4 LIGHTING CONTACTORS

- A. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

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- C. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.
- D. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- E. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details.
 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 3. Detail bus configuration, current, and voltage ratings.
 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include wiring diagrams for power, signal, and control wiring.
 9. Key interlock scheme drawing and sequence of operations.
 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
 - b. Outdoor Locations: NEMA 250, Type 3R
 - c. Wash-Down Areas: NEMA 250, Type 4X
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5
 - 2. Height: 84 inches (2.13 m) maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Convertible between top and bottom.
- G. Phase, Neutral, and Ground Buses Hard-drawn copper, 98 percent conductivity.

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- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. 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. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD.

2.3 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm high, provide two latches, keyed alike.
- C. Mains: Circuit breaker

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- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.
- G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: 120-V branch circuit

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: 120-V branch circuit
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. 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 Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.

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- c. Digital display of settings, trip targets, and indicated metering displays.
- d. Multi-button keypad to access programmable functions and monitored data.
- e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 8. Subfeed Circuit Breakers: Vertically mounted.
- 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NECA 407, NEMA PB 1.1.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- I. Install filler plates in unused spaces.
- J. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

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3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

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2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 - 1. Single Pole:
 - 2. Two Pole:
 - 3. Three Way:
- C. Pilot-Light Switches, 20 A:
 - 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 DECORATOR-STYLE DEVICES

- A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
- B. GFCI, Feed Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
- C. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- D. Lighted Toggle Switches, Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.
 - 1. Description: With neon-lighted handle, illuminated when switch is "off."

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2.7 RESIDENTIAL DEVICES

A. Fan Speed Controls:

1. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
2. Comply with UL 1917.
3. Continuously adjustable slider or toggle switch
4. Three-speed adjustable slider.

B. Telephone Outlet:

1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

C. Combination TV and Telephone Outlet:

1. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

2.8 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider or toggle switch with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant die-cast aluminum with lockable cover.

2.10 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red
3. TVSS Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

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2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- F. Dimmers:
1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of service poles to suit arrangement of partitions and furnishings.
- 3.2 GFCI RECEPTACLES
- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections:
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

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3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes automatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.3 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

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- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 2. Short-time withstand capability for three cycles.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
1. Comply with UL 869A and UL 489.
 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
 4. Provide removable link for temporary separation of the service and load grounded conductors.
 5. Surge Protective Device: Service rated.
 6. Ground-Fault Protection: Comply with UL 1008 for normal and alternative buses.
 7. Service Disconnecting Means: Externally operated, manual mechanically or electrically actuated.
- L. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles
- M. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- N. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- O. Battery Charger: For generator starting batteries.
1. Float type, rated [2] [10] A.
 2. Ammeter to display charging current.
 3. Fused ac inputs and dc outputs.
- P. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

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1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 4. Accessible via rear access.
- Q. Enclosures: General-purpose NEMA 250, Type 1 complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 5. Material: Hard-drawn copper, 98 percent conductivity.
 6. Main and Neutral Lugs: Mechanical type.
 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 8. Ground bar.
 9. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 3. Fully automatic break-before-make operation with center off position.
 4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

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- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- F. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

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G. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using contactor-based components are unacceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching.
 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 5. Material: Hard-drawn copper, 98 percent conductivity.
 6. Main and Neutral Lugs: Mechanical type.
 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 8. Ground bar.
 9. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

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1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 3. Fully automatic break-before-make operation with center off position.
 4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- F. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.
- G. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

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13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

H. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.4 NONAUTOMATIC TRANSFER SWITCHES

- A. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- B. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- D. Pilot Lights: Indicate source to which load is connected.

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- E. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- F. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching.
 - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 4. Material: Hard-drawn copper, 98 percent conductivity.
 - 5. Main and Neutral Lugs: Mechanical type.
 - 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 7. Ground bar.
 - 8. Connectors shall be marked for conductor size and type according to UL 1008.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - l. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 4. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, motor controls, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 271500 "Communications Horizontal Cabling."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."

- H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections

1. Visual and Mechanical Inspection:

- a. Compare equipment nameplate data with Drawings and Specifications.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and required clearances.
- d. Verify that the unit is clean.
- e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
- f. Verify that manual transfer warnings are attached and visible.
- g. Verify tightness of all control connections.
- h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
- i. Perform manual transfer operation.
- j. Verify positive mechanical interlocking between normal and alternate sources.
- k. Perform visual and mechanical inspection of surge arresters.
- l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

2. Electrical Tests:

- a. Perform insulation-resistance tests on all control wiring with respect to ground.
- b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
- c. Verify settings and operation of control devices.
- d. Calibrate and set all relays and timers.
- e. Verify phase rotation, phasing, and synchronized operation.
- f. Perform automatic transfer tests.
- g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.

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- 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Transfer switches will be considered defective if they do not pass tests and inspections.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

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- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. SPDs: Comply with UL 1449.
 - 1. SPDs with the following features and accessories:
 - a. Integral disconnect switch.
 - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - c. Indicator light display for protection status.
- B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- C. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 208Y/120 V.
 - 3. Line to Line: 1000 V for 208Y/120 V.
- D. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Line to Line: 1000 V.
- E. SCCR: Equal or exceed 100 kA
- F. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

- A. SPDs: Comply with UL 1449
 - 1. Include LED indicator lights for power and protection status.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

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- C. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 700 V for 208Y/120 V.
 - 3. Neutral to Ground: 700 V for 208Y/120 V.
 - 4. Line to Line: 1200 V for 208Y/120 V
- D. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Neutral to Ground: 700 V.
 - 4. Line to Line: 1200 V.
- E. SCCR: Equal or exceed 100 kA
- F. Inominal Rating: 10 kA.

2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

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1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.
3. Section 260933 "Central Dimming Controls" or Section 260936 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
4. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. CRI of minimum 70. CCT of determined by architect.
- F. Rated lamp life determined by architect of hours.
- G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: 120 V ac
1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- J. Housings:
1. determined by architect housing and heat sink.
 2. determined by architect finish.

2.3 CYLINDER

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. With integral mounting provisions.

2.4 DOWNLIGHT

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. Universal mounting bracket.
- C. Integral junction box with conduit fittings.

2.5 RECESSED LINEAR

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. Integral junction box with conduit fittings.

2.6 STRIP LIGHT

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. Integral junction box with conduit fittings.

2.7 SURFACE MOUNT, LINEAR

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. Integral junction box with conduit fittings.

2.8 SURFACE MOUNT, NONLINEAR

- A. Minimum lumens determined by architect. Minimum allowable efficacy of lumens per watt determined by architect.
- B. Integral junction box with conduit fittings.

2.9 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:

1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. housing and heat sink determined by architect.
2. Finish determined by architect.

2.10 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.11 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm)
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with minimum of two 5/32-inch- (4-mm-) diameter aircraft cable supports.
 - 2. Ceiling mount with pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports.
 - 3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

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3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:
- B. Product Certificates: For each type of luminaire.

- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
- D. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.
- F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

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1. Emergency Connection: Operate one lamp(s) continuously at an output of lumens determine by architect for each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet (1000 m).
 4. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 5. Battery: Sealed, maintenance-free, type.
 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- G. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
1. Emergency Connection: Operate LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote fixture continuously.
 4. Battery: Sealed, maintenance-free, type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.

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7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 1. Emergency Luminaires: Sheet E-1.0 as indicated on Interior Lighting Fixture Schedule. with the following additional features:
 - a. Operating at nominal voltage of 120 V ac.
 - b. Internal or External emergency power unit.
 - c. Rated for installation in damp locations, and for sealed and gasketed fixtures in wet locations.
 - d. UL 94 flame rating.
- C. Emergency Lighting Unit:
 1. Emergency Lighting Unit: Sheet E-1.0 as indicated on Interior Lighting Fixture Schedule.
 2. Operating at nominal voltage of 120 V ac.
 3. Wall or ceiling with universal junction box adaptor.
 4. UV stable thermoplastic housing, rated for damp locations.
 5. Two LED lamp heads.
 6. Internal or External emergency power unit.
 7. External emergency power unit.

2.4 EXIT SIGNS

- A. Internally Lighted Signs:
 1. Operating at nominal voltage of 120 V ac.
 2. Lamps for AC Operation: Fluorescent, two for each fixture; 20,000 hours of rated lamp life.
 3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
- B. Self-Luminous Signs:
 1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 10 years.
 2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

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2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Glass: Annealed crystal glass unless otherwise indicated.
2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Housing determined by architect.
2. Finish determined by architect.

E. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.6 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.

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D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls
2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265219

SECTION 265613 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.
2. Luminaire-lowering devices.

1.2 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.3 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.
- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified"
 2. For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

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- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.
- F. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
 - 1. Basic wind speed for calculating wind load for poles exceeding 50 feet (15 m) in height is 100 mph (45 m/s) [90 mph (40 m/s)]
 - a. Wind Importance Factor: 1.0
 - b. Minimum Design Life: 50 years
 - c. Velocity Conversion Factor: 1.0
 - 2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s) [90 mph (40 m/s)]
 - a. Wind Importance Factor: 1.0
 - b. Minimum Design Life: 25 years
 - c. Velocity Conversion Factor: 1.0
- H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

- A. Source Limitations: Obtain poles from single manufacturer or producer.
- B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
- C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.
 - 1. Shape: Determined by architect.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

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- D. Poles: Comply with ASTM A 240/A 240M, stainless steel with a minimum yield of 55,000 psig (379 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.
 - 1. Shape: Determined by architect.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- E. Steel Mast Arms: Single-arm continuously welded to pole attachment plate. Material and finish same as plate.
- F. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with galvanized-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- G. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- H. Fasteners: Galvanized steel size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- I. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- J. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.
- K. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5-inch (76-by-130-mm) handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.
- L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
- M. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- N. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.

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- O. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.
 - a. Color: Match Architect's sample.
- P. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Powder Coat: Comply with AAMA 2604.
 - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: Match Architect's sample.

2.3 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6063-T6, with access handhole in pole wall.
- B. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6061-T6, with access handhole in in pole wall.
 - 1. Shape: Determined by architect.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Mast Arms: Aluminum type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adaptor, then bolted together with stainless-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

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- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Fasteners: Stainless steel size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.
- I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- J. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
- K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: Match Architect's sample

- L. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Powder coat shall comply with AAMA 2604.
 - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: Match Architect's sample

2.4 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.
- B. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept indicated accessories. Include removable flanged access cover secured with bolts or screws.

2.5 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi (380,000 kPa).
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C
 - 2. Headed rods.
 - 3. Threading: Uniform National Coarse Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C
 - 2. nuts provided per anchor bolt
- C. Washers: ASTM F 436, Type 1.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C
 - 2. washers provided per anchor bolt.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
 - 1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.
- D. Direct-Buried Foundations: Install to depth indicated on Drawings, but not less than as indicated per structural. Add backfill in 6-inch (150-mm) to 9-inch (230-mm) layers, tamping each layer before adding the next. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
- E. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than as indicated by structural. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
 - 1. Make holes 6 inches (150 mm) in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi (20 MPa) at 28 days and finish in a dome above finished grade.
 - 3. Use a short piece of 1/2-inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.
- F. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

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3.2 POLE INSTALLATION

- A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
- C. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.
- D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.4 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundation.

END OF SECTION 265613

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboard-based lighting control.
3. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
4. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the specified seismic forces"

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598
- E. Lamp base complying with ANSI C81.61
- F. CRI of minimum 70. CCT determined by architect.
- G. L70 lamp life hours determined by architect.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Nominal Operating Voltage: 120 V ac
- J. In-line Fusing: On the primary for each luminaire
- K. Lamp Rating: Lamp marked for outdoor use

- L. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE TYPES

- A. Area and Site:
 - 1. Luminaire Shape: determined by architect
 - 2. Mounting: determined by architect
 - 3. Luminaire-Mounting Height: determined by architect
 - 4. Distribution: determined by architect

2.4 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.

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2.5 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: determined by architect.
- D. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. Provide all labor, materials, tools, transportation, equipment and incidentals necessary to perform the work as indicated on the Irrigation Plans and as herein specified.

1.02 SCOPE OF WORK

- A. Irrigation materials and equipment.
- B. Installation standards.
- C. System location and layout.
- D. Excavation and backfill.
- E. Installation of pipe, equipment, and appurtenances.
- F. Water flow meters.
- G. Field quality control – Coverage Tests.
- H. Plant establishment period.
- I. Clean up.

1.03 RELATED SECTIONS

- A. Related work specified elsewhere:
 - 1. 32 90 00 – Planting

1.04 REFERENCES

- A. The Standard Specifications for Public Works Construction, “Greenbook”, latest edition, is reference as if herein contained and the contractor shall keep a copy at the project site. These Specifications shall supersede conflicts with information given in the “Greenbook”, unless otherwise determined by the Owner or their designated representative.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2700 kN-m/m³))
 - 3. ASTM D1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - 4. ASTM D1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 5. ASTM D2241 Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)

- 6. ASTM D2464 Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- 7. ASTM D2466 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- 8. ASTM D2564 Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- C. California Code of Regulations, Title 24:
 - 1. Part 3 California Electrical Code
- D. Underwriters Laboratories Inc. (UL):
 - 1. UL 651 Schedule 40 and 80 Rigid PVC Conduit.

1.05 VERIFICATION OF DIMENSIONS

- A. Dimensions are approximate, before proceeding with any work, Contractor shall verify all dimension and shall immediately inform the L.A. and owner of any discrepancies between the drawings and/or specifications and actual field conditions. No work shall be done in any area where there is such a discrepancy until approval has been given by L.A. and owner. Any work done without notification and prior approval will be the sole responsibility of the Contractor to remedy as required by L.A. and Owner.

1.06 SUBMITTALS

- A. Contractor to supply submittals per contract documents, the following are required to be submitted to the Owners Representative prior to start of work.
- B. Existing Static water pressure/ Water service size verification:
 Static water pressure on site shall be recorded with an accurate liquid filled gauge capable of measuring 0-200 PSI (Winters PFQ806LF or equal). Measurements shall be taken as early as possible per available source and at a time no other distribution devices are actively running. Contractor to document readings in writing on Contractors form that list time & date, reading in PSI, location, and type of gauge used in addition to date stamped photographs of readings. Contractor to document all points of service including both potable and recycled. Final results shall be submitted to the Owners representative prior to purchase of equipment.
- C. Materials List:
 - 1. Complete material list shall be submitted prior to performing any work. Catalog data and full descriptive literature must be submitted whenever the use of the item is different than those specified is requested. Notarized certificate must be submitted by plastic pipe and fitting manufacturer indicating that material complies with specifications, unless material has been previously approved.
 - 2. Material list shall be submitted using the following format (double spaced between each item):

<u>Item</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>
1.	Pressure Pipe	Lasco	Sch. 40
2.	Lawn Head	Rainbird	1804-SAM-PRS
Etc.	Etc.	Etc.	Etc.

D. Record Drawings:

1. Record accurately on one set of contract drawings all changes in the work constituting departures from the original contract drawings daily including noting when work was done.
2. The changes and dimensions shall be recorded in a legible and workmanlike manner to the satisfaction of the Owners Representative. Prior to final inspection of work, submit record drawings to Owners Representative for approval.
3. Dimensions shall be from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavement, etc.). Data to be shown on record drawing shall be recorded day to day as the project is being installed. All lettering on drawings shall be minimum 1/8 inch in size.
4. Show locations and depths of the following items:
 - a. Point of connection.
 - b. Routing of sprinkler pressure lines (dimension maximum 100 feet along routing)
 - c. Gate valves/ Isolation valves.
 - d. Sprinkler control valves.
 - e. Quick coupling valves.
 - f. Routing of control wires.
 - g. Related equipment (as may be directed).
5. Maintain record drawings on-site at all times. Upon completion of work, transfer all as-built information and dimensions to clean blackline prints for reproduction.

E. Operation and Maintenance Manual: Operation and Maintenance Data, for submittal requirements. As a minimum, provide operation and maintenance instructions for the following items:

1. Electric Remote-Control Valves (including master control valves);
2. Satellite Irrigation Controllers;
3. Water Flow Meters; and
4. Irrigation Controller Software.

1.07 QUALITY ASSURANCE

- A. The landscape irrigation system shall consist of a completely automatic, electrically-controlled bubbler, drip, and spray-irrigation system. The system shall be installed to provide complete coverage with minimum maintenance. The irrigation system shall be installed to prevent overspray onto walks and structures.
- B. The irrigation system shall avoid conflicts with plant materials, lighting standards, sign posts, architectural features, above and below ground utilities, and drainage system. Contractor responsible for coordination with other trades to verify acceptable locations to avoid conflicts.
- C. Irrigation piping layout is schematic, showing location of pipes and fittings close to landscape areas is not always possible graphically. All equipment shall be located inside the landscape areas.

- D. In some cases, Manufacturer standards/requirements may be in addition or supersede those items shown via the plans and details. It is the Contractors responsibility to review and verify with the manufacturer all the required and up to date equipment and accessories are included in addition or in leu of items shown via the plans. At all times the Manufactures requirements shall take precedence and as the installation expert the Contractor shall be responsible for installing the most up to date and current equipment per the manufacturers requirements to ensure full compliance with guarantee, certification, and warrantee requirements as part of their bid.
- E. Plant establishment period is specified in Section 32 93 00 – Plants.

1.08 SEQUENCING AND SCHEDULING

- A. Contractor to coordinate layout and installation of irrigation sleeves, conduits, and piping under paved areas and other features prior to their construction.
- B. Coordinate installation of irrigation system with excavation of planting beds and backfilling of planting beds with topsoil. Refer to Section 32 90 00, Planting, for requirements. Typically, the irrigation system shall be installed after planting beds have been excavated and backfilled with topsoil.
- C. The irrigation system shall be installed and tested prior to installation of plant material. Coordinate layout and installation of irrigation system with location and installation of plant material to assure that there will be complete and uniform irrigation coverage of planting as indicated.
- D. Tree locations shall be staked in the field prior to installation of irrigation pipe and heads. Refer to the plant list on the Contract Drawings for plant setbacks and spacing requirements.

1.09 EXISTING UTILITIES

- A. Existing utilities and conditions: Prior to cutting into the soil, locate all cables, conduits, sewer lines, septic systems, and other utilities commonly encountered underground and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, promptly notify the L.A. and Owner who will give direction. Proceed in the same manner if a rock layer or any other conditions encountered underground make changes advisable.
 - 1. Where investigation of subsurface conditions has been made by a qualified body in areas in which local materials may be obtained, the Contractor may request the use of such information but will be solely responsible for its verification and accuracy
 - 2. It is the Contractors sole responsibility to verify any located or demarked utilities via pot holing or other method prior to start of excavation. Failure to do so will result in all damages being the sole responsibility of the Contractor.

1.10 INSPECTIONS

- A. Inspections will be required for:
 - 1. Pressure test of irrigation main line.
 - 2. Coverage test.
 - 3. Manufacture certification, for warranty, verification of installation per manufacture requirements.

4. Final inspection/start of maintenance. Final inspection shall be performed by the Owners Representative and Landscape Architect
 - a. Final inspection shall include verification of complete installation per plans
 - b. All Sensors, gauges, grounding, and accessories must be installed and functioning/programed per manufacture requirements
 - c. Third party water audit of system per MWELO requirements, Contractor shall be responsible for supplying water audit and results/ report to Owner's representative as completed by a Certified Landscape Irrigation Auditor(CLIA).
 5. Completion of maintenance and owners' Final acceptance.
- B. Inspection Requests:
1. Contractor shall notify the Owners Representative and Landscape Architect in advance for requesting all inspections as follows:

Pressure supply line installation and testing - 36 hours (1- 2 working days)

System layout - 36 hours (1- 2 working days)

Coverage Tests - 36 hours (1- 2 working days)

Final Inspection - 48 hours (2 working days)
 2. When inspections have been conducted by other approved personnel, the Contractor shall show evidence in writing of when and by whom these inspections were made including a signature of the referenced Inspector.
 3. No inspection will commence without "record" prints. In the event the Contractor calls for an inspection without up to date "record" prints, without completing previously noted corrections, or without preparing the system for inspection, the inspection will be canceled and the Contractor back charged for the direct costs of all Owners Representative time and consultant time lost.
- C. Closing in Uninspected Work:
1. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been inspected, tested, and approved by the Owners Representative.
 2. Any additional inspections required due to the Contractors actions, such as failing to have work inspected or covering it prior will- result in additional inspections charged by the current hourly rate of the Landscape Architect or Certified Irrigation designer/Auditor including travel time and expenses.
- D. Coverage Test and Adjustment:
1. When the sprinkler system is completed, Contractor shall perform a coverage test in the presence of the Owners Representative and the Landscape Architect to determine if the water coverage for planting areas is complete and adequate. This test shall be accomplished before any planting.
 2. Any adjustment required for proper coverage shall be the Contractors Responsibility, and shall include field adjustments and additions as needed to head layout as directed by the Landscape Architect. All additional cost associated with final system tuning and adjustments shall be the Contractors Responsibility.
- E. Hydrostatic Tests:

1. All pressure lines shall be tested under a hydrostatic pressure of 150 psi for a period of not less than two hours or per local governing regulation- whichever is greater.
 2. All hydrostatic tests shall be made in the presence of the Owners Representative. No pressure line shall be backfilled until it has been inspected, tested, and approved in writing.
- F. Contractor shall furnish necessary force pump and all other test equipment.

1.11 TURNOVER ITEMS

A. Controller Charts:

1. Record drawings must be approved by Owners representative before charts are prepared.
2. Provide one controller chart for each automatic controller. Chart shall show the area covered by controller.
3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
4. Chart shall be a blackline print with a different color used to show the area of coverage for each station.
5. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

B. Operation and Maintenance Manuals:

1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Owners Representative 10 calendar days prior to final inspection. The manuals shall describe the material installed.
2. Each complete, bound manual shall include the following information:
 - a. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
 - b. Complete operating and maintenance instructions for all equipment.
 - c. Spare parts lists and related manufacturer information for all equipment.

C. Equipment:

1. Supply as part of this contract the following items:
 - a. 4 additional sprinkler heads of each type and spray pattern shown.
 - b. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head involved.
 - c. 10 additional drip emitters of each type and flow rate shown.
 - d. 25' of each type of drip tubing per plan, and 6 of each fittings used.
 - e. Two keys for each automatic controller.

- D. Contractor to supply and verify with the Owners Representative what type of padlocks and keys are required for all enclosures that can be secured as part of their bid. Each locking mechanism must have 4 copies of the correct key for turnover to the Owners Representative. Depending on actual enclosures per plan this includes locks for gates, any needed chains/cables, and other security instruments for the protection of Irrigation equipment.

1.12 GUARANTEE**A. General:**

The entire sprinkler system, including all work done under this contract, shall be guaranteed against all defects and fault of material and workmanship for a period of one (1) year following the filing of the Notice of Completion. All materials used shall carry a manufacturer's guarantee of one (1) year.

Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to the Owner within ten (10) calendar days of receipt of written notice from the Owners Representative. When the nature of the repairs as determined by the Owners Representative constitute an emergency (e.g. broken pressure line) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owners Representative by the Contractor, all at no additional cost to the Owner.

B. Form of Guarantee: Guarantee shall be submitted on Contractors own letterhead as follows:

FORM OF:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the complete irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications. We agree to repair or replace any defects in materials or workmanship which may develop during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. This shall include all defects and failures in workmanship and the results of such issues such as trench settling, erosion as caused by failures or defects, and including plant replacement. We shall make such repairs or replacements within 10 calendar days following written notification by the Owners Representative. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from the Owners Representative, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT: _____

LOCATION: _____

SIGNED: _____

ADDRESS: _____

PHONE: _____

PART 2 - PRODUCTS**2.01 GENERAL**

- A. Materials and or equipment installed or furnished shall be new and in pristine condition. Materials that have faded, are dirty, or have been improperly stored will be rejected and shall be removed from the site and replaced at no expense to the Owner.
- B. All materials shall be stored per manufactures recommendation and protected from, weather, construction activities, and vandalism/theft.

2.02 PIPE

- A. Pressure supply line from point of connection through backflow prevention unit shall be Type 'K' brass or copper pipe.
- B. Pressure supply lines 2-1/2 inches in diameter and up to 6 inches in diameter downstream of backflow prevention unit shall be Class 315 solvent weld PVC.
- C. Pressure supply lines 2 inches in diameter and smaller downstream of the backflow prevention unit shall be Schedule 40 solvent weld PVC.
- D. Non-pressure lines shall be Schedule 40 solvent weld PVC.

2.03 COPPER PIPE AND FITTINGS

- A. Copper pipe shall be Type 'K', hard tempered ASTM B 88 and fittings shall be wrought solder joint type in accordance with ANSI B16.22.
- B. Joints shall be soldered with silver solder, conforming to ASTM B206.

2.04 BRASS PIPE AND FITTINGS

- A. Brass pipe shall be 85 percent red brass, ANSI, Schedule 40 screwed pipe.
- B. Fittings shall be medium brass, screwed 125-pound class.

2.05 GALVANIZED STEEL PIPE AND FITTINGS

- A. All galvanized steel pipe shall be Schedule 40, threaded, coupled, and hot-dipped galvanized, and shall comply with the requirements of ASTM A 120-66 or ASTM A 53-67.
- B. All fittings for galvanized steel pipe shall be 150-pound rated galvanized malleable iron, banded pattern.
- C. Pipe sizes indicated on the drawings are nominal inside diameter, unless otherwise noted.

2.06 CONDUIT

- A. Conduit: Provide rigid non-metallic conduit conforming to UL Standard No. 651 for rigid non-metallic conduit, such as Schedule 40 PVC conduit, unless otherwise indicated.

2.07 PLASTIC PIPE AND FITTINGS

- A. All plastic pipe shall bear the following markings: manufacturer's name, nominal pipe size, schedule or class, type of material, pressure rating in psi, NSF seal of approval, and the date of extrusion.
- B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound.

- C. Rubber gasket PVC pipe, couplings, and fittings shall conform to ASTM D 1784 Type I, Grade I, 2,000-psi design stress. Couplings, rubber gaskets, and fittings shall be as approved by the pipe manufacturer.
- D. Ring-type rubber gasket couplings shall permit a 5-degree deflection of the pipe at each coupling (2-1/2 degree each side) without exfiltration or infiltration, cracking or breaking.
- E. All fittings shall be standard weight Schedule 40 and shall be injection molded of an improved PVC fitting compound. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated.
- F. When connection is plastic to metal, male adapters shall be used. The male adapter shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be nonhardening sealing compound compatible with plastics. Compound must not lubricate the joint.
- G. All threaded nipples shall be standard weight Schedule 80 with molded threads.
- H. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy.

2.08 BACKFLOW PREVENTION UNITS

- A. The backflow prevention unit shall be as indicated on the drawings.

2.09 BACKFLOW PREVENTION ENCLOSURE

- A. The backflow prevention device enclosure shall be as indicated on the drawings or approved equal. Install one for each backflow device.

2.10 BOOSTER PUMP

- A. The Pump unit shall be as indicated on the drawings if required.

2.11 VALVES

A. Gate and Ball Valves:

- 1. Ball valves 2 inches or smaller shall have screwed joints and brass bodies.
- 2. All gate valves larger than 3 inches in diameter shall have 2-inch-square operating units and have an arrow cast in the metal indicating the direction of opening. Valves shall have iron body and be bronze mounted.
- 3. All gate valves larger than 2 inches and up to 3 inches in diameter shall conform to (1) or (2) above.
- 4. All gate valves shall have a minimum working pressure of not less than 150 psi and shall conform to AWWA standards.

B. Quick Coupling Valves:

- 1. Body of valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 3/4-inch female threads opening at base, with two-piece body. Construct valves to be operated only with a coupler, designed for that purpose. Coupler is inserted into valve and a positive, watertight connection shall be made between coupler and valve. Hinge cover shall be brass with a yellow rubber-like vinyl cover bonded to it.

C. Remote Control Valves:

1. Valves shall be spring-loaded, self-cleaning, packless diaphragm activated, of a normally closed type.

2.12 VALVE BOXES

- A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be secured with a hidden latch mechanism or bolts.
- C. The cover and box shall be capable of sustaining a load of 1,500 pounds.
- D. Valve box extensions shall be by the same manufacturer as the valve box.
- E. Gate valve boxes shall be round plastic boxes with bolt-down covers marked "GV," heat branded in 2" high characters; AMETEK or approved equal.
- F. Remote control valve boxes shall be rectangular plastic boxes with bolt-down covers marked "RCV"; and with the valve identification number heat branded in 2" high characters; AMETEK or approved equal.
- G. Colors of boxes shall be green unless otherwise called out by the plans.
- H. Valve boxes shall be sized to fit all equipment with ample room for operation and any required maintenance tasks, Contractor to adjust as needed per field conditions and final assembly of components at no additional cost.

2.13 AUTOMATIC CONTROLLER

- A. Automatic controller shall be as called for on the plans and include all options and accessories required to function independently and automatically, including receiving updated climate information, flow sensing, and information for programming adjustments as required by the model.
- B. Contractor to include in bid all support items required by the manufacture for a fully functional automatic irrigation control system, including if required:
 1. All relays, pump starts
 2. Flow sensors
 3. Decoders
 4. Coaches switch/Cool down controls
 5. Remotes
 6. Specialized wire connections per manufacturer
 7. Grounding for accessories per manufacturer

2.14 ELECTRICAL

- A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installation.
- B. All electrical work shall conform to local codes and ordinances.

2.15 WIRING

- A. Remote control wire shall be direct-burial AWG-UF type, sized according to manufacturer's specifications per the drawings, and in no case smaller than 14 gauge.
- B. Wire connectors shall be either Spears Dri-Splice, 3M DBR/Y, and or 3M 3570GN Direct burial type water proof connectors per the details or the manufacturers requirement's which ever more stringent.
- C. Common wires shall be white in color. (Where two or more controllers are used, the common wires shall be white with a different color stripe for each controller.) Control wires shall be black (where two or more controllers are used, the control wires shall be a different color for each controller.) These colors shall be noted on as-built plans located on controller door.
- D. All wires shall be numbered and marked with 3M wire marking tape numbering system or approved substitution at the controller and any pull boxes where more than 10 wires are present.

2.16 SPRINKLERS

- A. Sprinklers shall be as called for on the plans.

2.17 FERTIGATION

- A. If called for on the plans shall be provided by Eco-Fert fertigation. Contractor shall coordinate installation and programming with Eco-Fert. Eco-Fert System Number EFSS-FP1. Coordinate Installation with Eco-Fert (949) 766-5800 and include all conduits and electrical service for installation. Fertigation system shall include, but not be limited to the following components as a minimum:
 - Walchem Pump
 - Signet 9900
 - Schedule 80 4" fittings
 - Extension Boxes
 - GF 2536
 - Saddle
 - Stainless Steel Cabinet/Pedestal
 - Tank
 - 4 pin connectors
 - 5 pin connectors
 - Madison Horz float
 - Valve Boxes
 - Fan.

PART 3 - EXECUTION**3.01 GENERAL****A. Water Supply:**

1. Connections to or for the installation of the water supply shall be at the locations shown on the drawings. Any changes caused by actual site conditions shall be made at no additional cost to the Owner.

B. Electrical Service:

1. Contractor shall make and supply all electrical connections including conduit, wiring, and support breakers and switches to supply the irrigation controller, booster pump, and fertigation system in addition to any required ancillary equipment.

C. Layout:

1. Layout irrigation system prior to excavation and make minor adjustments required due to differences between site and diagrammatic drawings/plans. All equipment to be located within planter areas. It is the Contractors responsibility to notify the Landscape Architect of any items of concern prior to start of installation. Any changes in layout or design by the Contractor not disclosed and approved prior by the Landscape Architect are made at the Contractors sole liability.

D. Diagrammatic Intent:

1. The drawings are purposely diagrammatic, due to scale it is impossible to show all items in their actual location on the plan. The size and location of equipment and fixtures are drawn to scale where possible to show overall system makeup and design. Provide offsets in piping and changes in equipment locations as necessary to conform with structures, hardscape, and to avoid obstructions or conflicts with other work. Contractor shall not willfully install any equipment that would be out of place, cause issue/ interference with other work, or appear to be out of location per industry standards. All equipment shall be located in landscape areas unless specifically approved by the Owners Representative prior to installation for any non-conforming circumstances.

E. Modifications:

1. Provide modifications to the irrigation system to avoid blockage of sprinkler irrigation patterns, to prevent overspray and excessive runoff onto walkway and parking areas, and to provide full irrigation coverage to the planted areas. Such modifications also include adjusting locations and adding heads as required to spray around trees, light poles, sign posts, other objects that obstruct spray pattern, and any other adjustments required due to field conditions unknown at the time of design. All cost's associated with Modifications are the Contractors sole responsibility as they shall be considered part of the bid.

F. Grades:

1. Before starting work, carefully check all grades to determine that the site is properly graded and work may safely proceed, keeping within the specified material depths with respect to finish grade.

G. Inspections:

1. Prior to all work of this section, carefully inspect the current work of all other trades and verify that all such work is complete to the point where this installation may properly

commence. Any installation prior to the completion of other trades that requires work to be adjusted or redone is the sole responsibility of the contractor.

2. Verify existing grades are correct and that proper coverage per the details and final equipment locations and heights are correct. Any work installed that is found to be incorrectly installed per the details that requires adjustment to equipment or pipe relocation is the sole responsibility of the Contractor.
3. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

H. Discrepancies:

1. In the event of discrepancy, notify the Owners Representative and the Landscape Architect prior to starting work.
2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved and approval of solution has been granted in writing.
3. Failure of the Contractor to accurately lay out or knowingly install the system in a way that creates design inadequacies without prior acknowledgement to the Owners Representative will be the direct responsibility of the Contractor to remedy without any additional costs or impact to the Owner.

I. Field Measurements:

1. Contractor shall be responsible to make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other trades, including the proper location of required sleeves, and support items that may involve other trades.

3.02 INSTALLATION STANDARDS

- A. The landscape irrigation system shall be installed in accordance with applicable requirements of the California Plumbing Code and California Electrical Code, and the requirements of the jurisdictional water company or utility district.
- B. Manufactured materials and equipment shall be installed in accordance with the respective manufacturer's instructions for the location and conditions.

3.03 TRENCHING

- A. Dig trenches and support pipe continuously on bottom of ditch. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.
- B. Contractor responsible for all trenching activities which shall be in accordance with current safety and OSHA requirements.
- C. Provide minimum cover of 24 inches, maximum 30 inches on pressure supply lines 3 inches and larger.
- D. Provide minimum cover of 18 inches, maximum 24 inches on pressure supply lines 2 inches and smaller.

- E. Provide minimum cover of 4" for subsurface drip lines, or as recommended by the subsurface drip line manufacture.
- F. Provide minimum cover of 18 inches, maximum 24 inches for control wires.
- G. Provide minimum cover of 12 inches, maximum 16 inches for non-pressure lines.
- H. Provide minimum cover of 24 inches, maximum 30 inches for all pipe sleeved under paving.
- I. Provide minimum cover of 36 inches in infiltration areas (6" minimum backfill cover over pipe beneath gravel layer).
- J. When two pipes are to be placed in the same trench, maintain a six-inch space between pipes as a minimum. No pipe shall be installed directly over or next to another
- K. For pressurized lines, snake as needed in the trench to allow for minor expansion and contraction depending on the type of pipe used. Follow manufactures recommendations.
- L. Where it is necessary to excavate adjacent to existing trees, the Contractor shall avoid injury to trees and tree roots. Excavation in areas where 2-inch and larger roots occur shall be done by hand. All roots 2 inches and larger in diameter shall be tunneled under and shall be heavily wrapped with wet burlap to prevent scarring or drying. Where trenching machine is run close to trees having roots smaller than 2 inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making a clean cut through the roots. Roots 1 inch and larger in diameter shall be painted with two coats of Tree Seal or approved equal. Trenches adjacent to trees shall be closed within 24 hours. Any damage to tree root structure and resulting decline will be the sole responsibility of the Contractor.
- M. After trenches have been excavated, pipe shall be installed, tested, and inspected, and the trench shall be backfilled without undue delay.

3.04 PIPING

- A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphaltic concrete pavement.
- B. Cutting or breaking of existing pavement is not permitted.
- C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, and burrs and reaming; install pipe with all markings up for visual inspection and verification.
- D. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings; store plastic pipe and fittings under cover until ready to install; transport plastic pipe on a vehicle with a bed long enough to allow the pipe to lay flat, avoid undue bending and any concentrated external load.
- E. Remove all dented, crushed, scratched, and damaged pipe sections.
- F. Contractor shall install concrete thrust blocking at all changes of direction and terminal points of pressure pipe per plans.
- G. All lines shall have a minimum clearance of 6 inches from each other and 12 inches from lines of other trades.
- H. Parallel lines shall not be installed directly over one another.
- I. In solvent cementing/welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods; allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.

- J. Solvent cementing/ welding shall be neat and demonstrate quality workmanship- Primer and Glue shall not be used in excess or applied in a way to affect the portions of the pipe that are not part of the actual connected joint. Any joints with excessive runs/drips, trails, or globing of Glue and or Primer shall be cut out in whole and replaced at cost by the Contractor until an acceptable professional product is completed and accepted by the Owners Representative
- K. 360-degree applicators shall be used to apply primer and solvent on sizes - 2 inches and larger.
- L. Center load all plastic pipe prior to pressure testing.
- M. All threaded plastic-to-plastic connections shall be assembled using Teflon tape.
- N. For plastic-to-metal connections, work the metal connections first. Use a nonhardening pipe dope on all threaded plastic-to-metal connections, except where noted otherwise.
- O. Snake all piping to allow for expansion and contraction due to environmental conditions.

3.05 ASSEMBLIES

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practice.
- B. Install backflow assemblies at locations approved in the field and at height required by local codes.
- C. Valves shall be installed in Landscape areas whenever possible per Owners Representative standards.
- D. Each valve box shall be installed on a foundation of gravel backfill; 3 cubic feet minimum. Place boxes on common bricks bedded in backfill per details. Valve boxes shall be installed with their tops ½" inch above the surface of surrounding finish grade in lawn areas and 2" inch above the surface of surrounding finish grade in shrub areas or per details.
- E. Valve box risers or extensions shall be installed as needed per field conditions at no additional cost, they shall be by the same manufacture as the installed box.
- F. Areas with burying rodents will require metal fabric or wire mesh installed under boxes prior to gravel and shall be placed at all other possible entry points to protect the equipment from damage. All cost associated with wire fabric installation shall be the responsibility of the contractor.

3.06 BACKFILLING

- A. Before pipeline trenches are backfilled, the irrigation system shall be pressure tested and the location of irrigation heads modified as required to obtain complete and uniform coverage of each plant's root ball. Refer to field quality control requirements specified herein.
- B. Initial backfill on all lines shall be of fine granular material with no foreign matter larger than 2 inch in size. Reference section 217-1.1 of the "Greenbook" for further requirements of bedding material. All protruding rocks or other material capable of damaging pipe will shall be removed from trench walls or bottom prior to placement of pipes or conduits.
- C. Compaction of backfill in landscaped areas shall be not less than that of surrounding ground as determined by ASTM D1557.
- D. Backfill shall be tamped in 4-inch lifts under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Materials shall be sufficiently damp to permit

thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.

- E. Flooding in lieu of tamping is not allowed without specific prior approval.
- F. Under no circumstances shall truck wheels be used to compact soil.
- G. Provide washed sand backfill a minimum of 6 inches over and under all piping under paved areas.

3.07 CONTROLLER

- A. The exact location of the controller shall be approved by the Owners Representative before installation. The electrical service shall be coordinated to this location by the Contractor.
- B. Fertigation controller will be located next to fertigation unit per plan if included. Maintenance access shall be provided.
- C. Pump starter shall be connected to controller pump starter relay switch.
- D. The irrigation system shall be programmed to operate during the periods of minimal use of the design area, and for maximum efficiency.
- E. Testing Requirements:

All manufacturer requirements for certification and or warranty release of the system in addition to electrical code requirements are the Contractors responsibility to meet and supply proof in the form of documentation of inspection and compliance.

3.08 WIRING

- A. Wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines and shall be located below the supply lines wherever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of 10 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.
- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional turn, and one of 24 inches shall be provided at each remote-control valve.
- E. A continuous run of wire shall be used between a controller and each remote-control valve. Under no circumstances shall splices be used without prior approval.

3.09 FLUSHING THE SYSTEM

- A. Prior to installation of sprinkler heads, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Sprinkler heads shall be installed after flushing the system has been completed.

3.10 SPRINKLER HEADS

- A. Sprinkler heads shall be installed as designated on the drawings and per Owners Representative standards.
- B. Spacing of heads shall not exceed maximum indicated on the drawings.

3.11 ADJUSTING THE SYSTEM

- A. Contractor shall adjust valves, align heads, and verify coverage of each system prior to coverage test.
- B. If it is determined by the Owners Representative that additional adjustments, heads or nozzle changes/ additions will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to acceptance and any planting. (See 3.01 section E)
- C. The entire system shall be operating properly before any planting operations commence.

3.12 PLANT ESTABLISHMENT

- A. Contractor to continually check and adjust the system for proper run times, coverage, and function throughout the Plant Establishment Period listed in Section 32 93 00 – Plants.

3.13 COMPLETION CLEANING

- A. Upon completion of the work, Contractor shall smooth all ground surfaces; remove excess materials, rubbish, debris, etc.; sweep adjacent streets, curbs, gutters, walkways, and trails; and remove construction equipment from the premises. Contractor is responsible for removing and cleaning any tracking, tire marking, or other visible signs of damage to existing facilities.

END OF SECTION

SECTION 32 90 00**PLANTING****PART 1 – GENERAL****1.01 SCOPE**

- A. The work required is indicated on the drawings and includes but is not necessarily limited to: soil preparation; finish grading; planting trees; guying and staking trees; planting shrubs and ground cover; soil erosion control; maintenance; plant establishment period; guarantees; and replacement.

1.02 RELATED SECTIONS

- A. Related work specified elsewhere:
 - 1. 32 84 00 Planting Irrigation
 - 2. 32 90 05 Planting Maintenance

1.03 GUARANTEE

- A. All trees installed under the contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship of installation for a period of one (1) year.
- B. All plant material 15 gallon or larger shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship of installation for a period of one (1) year.
- C. During the guarantee period, any material found to be dead, in decline, missing, or in poor condition shall be replaced by the Contractor within ten (10) days of written notification. The Owners Representative/ Landscape Architect shall be the sole judge as to the condition of the material.
- D. Replacement shall be made in accordance with these specifications and the plans and shall be material matching the current size and condition of the existing material at the time of replacement.
- E. Material and labor involved in replacing plant material shall be provided by the Contractor at no additional cost to the Owner including any shipping, delivery, and or specialized installation methods such as craning, rigging, or impact to surrounding landscape.

1.04 REFERENCES

- A. The Standard Specifications for Public Works Construction, "Greenbook", latest edition, is reference as if herein contained and the contractor shall keep a copy at the project site. These Specifications shall supersede conflicts with information given in the "Greenbook", unless otherwise determined by the Owner or their designated representative.

1.05 QUANTITIES AND TYPES

- A. Plant materials shall be furnished in the quantities and/or spacing as shown and noted for each location, and shall be the species, kinds, sizes, etc. as symbolized and/or described in the "Plant Materials Legend", as indicated by the drawings. The Landscape Architect has provided this list and/or counts only as a convenience to the Owner and Contractor and assumes no responsibility for its accuracy. As part of his/her bid the Contractor shall be solely responsible for accurately identifying the counts and species as shown on the plans by symbols. Any questions or clarifications shall be brought up during the bidding process or shall be resolved as solely directed by the Owners Representative or Landscape Architect.

1.06 VERIFICATION OF DIMENSIONS

- B. Dimensions are approximate, before proceeding with any work, Contractor shall verify all dimension and shall immediately inform the L.A. and owner of any discrepancies between the drawings and/or specifications and actual field conditions. Minor adjustments to planting locations for interference with infrastructure or other site features shall be included in the bid by the contractor. No work shall be done in any area where there is such a discrepancy until approval has been given by L.A. and owner. Any work done without notification and prior approval will be the sole responsibility of the Contractor to remedy as directed by L.A. and Owner.

1.07 INSPECTIONS

- A. Inspections will be required to observe and verify the work. The Contractor shall contact the Owners Representative at least 48 hours (2 working days) in advance of an anticipated inspection. An inspection will be required at each of the steps listed below:
1. Upon completion of fine grading, and prior to commencement of soil preparation, for acceptance of fine grading work and taking of soils samples.
 2. Inspection of completed finish grading work per this section following soil amendment work.
 3. Percolation test of selected planting tree locations.
 4. On site delivery of plant material.
 5. When trees and shrubs are spotted for planting, but before planting holes are excavated.
 6. When planting and all other indicated or specified work has been completed.
 7. During application of pre-emergent chemical.
 8. At start of plant establishment and maintenance period.
 9. At the end of the plant establishment period, concurrent with final acceptance of the project for maintenance by the Owner. This acceptance for maintenance will be confirmed in writing by the Landscape Architect or Owners Representative.

1.08 SOILS TEST

- A. Agronomic soil analysis shall be required with interpretation and recommendations (include texture, organic matter, estimated nitrogen release, Phosphorus (P 1, P 2), potassium, magnesium, calcium, soil pH, hydrogen, cation exchange capacity, percent base saturation, soluble salts, excess lime rate, sodium and boron at the acceptance of fine grading. Total amount of tests required shall be as stated per the per plans or at a minimum of 1 test per 25,000 sq. ft. whichever is greater. The tests shall be individual to identify any irregularities in soil types on site and amend them as necessary per plant or area needs. Creating a single composite mix of all samples is not allowed. The final approved recommendation shall take precedence over the minimums listed herein or elsewhere in the plans. Recommendations shall be based on the plants listed per the planting plans specifically. The recommendations shall call for any needed special requirements for the listed trees, shrubs, ground covers, turf, and or any other special specie requirements. Any additional costs due to recommendations of the soil test shall be the responsibility of the Contractor who has reviewed the site during bidding and made their own observations and test as needed to make an accurate bid based on the site conditions and their experience as a Contractor. See plans for amount and locations of tests required based on project size. All costs for testing shall be the responsibility of the Contractor and included in their bid as well as the proper scheduling allowing for analysis and reporting lead times.
- B. Any results or recommendations that require additional re-testing to verify required mitigation or amendments performance shall be included by the contractor at no cost to the owner.
- C. Any Additional mitigation or amendments that may be required by as stated by additional testing and are found to be a result of the Contractor failing to meet the original requirements shall be corrected in full to the requirements of the recommendations by the Contractor at no cost.

1.09 SUBMITTALS

- A. Contractor to submit date stamped photos documenting current appearance of each plant listed in the plant legend within 15 days of the Notice to Proceed. Photos shall clearly document size and condition from the nursery, including height, spread, and size of caliper noted for trees for approval by Landscape Architect.
- B. In addition to photos the Contractor shall supply documentation of the required quantities available from the supplier at the time of submittal, it is the Contractors responsibility to procure all plant material ahead of delivery once the submittal is approved. Any additional cost as a result of scheduling or order of operations for holding, growing, and caring for plant material shall be included in the Contractors bid.
- C. Contractor to submit written recommendations from a Certified Pest Control Advisor for all herbicides and pesticides to be used on site for approval by Landscape Architect.
- D. Contractor to submit samples of Mulch or other listed ground cover material per plan in a 1-gallon zip-lock type plastic bag for approval by Landscape Architect.

- E. The following written certifications and or delivery tickets are required to be submitted to the Landscape Architect upon delivery of the respective materials to the job site:
 - 1. Total Quantity of commercial fertilizers by type
 - 2. Total Quantity of soil amendments and conditioners by type
 - 3. Total Quantity of mulch
 - 4. Total Quantity of iron sulphate
 - 5. Also, all items per section 32 92 00 (turf seeding or sod if applicable)
- F. All bagged products (fertilizers, etc.) shall stay on the site in a neat and orderly manner until the final approval by the Landscape Architect.

1.11 SUBSTITUTIONS

- A. Substitutions for any indicated plant material shall be permitted only if the provided substituted materials are approved in advance at the start of work, and if found to be acceptable by the L.A. with no additional costs to the owner. The L.A. has final authority on the approval of substitutions based on their opinion of overall impact to plant palette and the substitutions previous performance. No substitutions shall be allowed based on failures of the Contractor to locate and reserve plant quantities at the time of award. For any additional required inspections, nursery visits, or staff time spent verifying additional plant material after the original approval will be the responsibility of the Contractor and charged at the Landscape Architects current rates at time of Design Award.

1.12 PROOF OF PLANT MATERIAL NURSERY DEPOSIT/PURCHASE

- A. The Contractor shall be responsible for proof of plant material procurement prior to submission of first Pay Application. Plant material must be located, have submittals approved, and some form of either deposit or full payment for reserving the plant material and any ongoing maintenance required by the seller based on the Contractors approved schedule for plant delivery to the site. Failure to provide the documentation of proof of purchase will result in a delay of payment approval and processing. This is required due to supply chain issues and limited availability of plant material in the current market conditions and there affect on project timelines if not secured at the properly at start of the project.

1.13 WARRANTY

- A. General:
- B. The Contractor shall guarantee all plant material against all defects and fault of material and workmanship for the entire period of the plant establishment/maintenance periods. The Contractor shall guarantee all trees and plant material 15 gallon and larger for a period of one year from completion of plant establishment. Any trees that fail or are found to be in decline shall be replaced by the Contractor at no cost to the owner. The final decision on the health and status of the material will be the sole discretion of the

Landscape Architect and or the Owners Representative.

- C. Should any problem with the planting installation be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to the Owner within ten (10) calendar days of receipt of written notice from the Owners Representative. When the nature of the repairs as determined by the Owners Representative constitute an emergency (I.E. Tree failures, Etc.) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvements resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owners Representative by the Contractor, all at no additional cost to the Owner.

PART 2 - MATERIALS

2.01 SOIL AMENDMENTS, FERTILIZER, AND CONDITIONERS

Samples of soils amendments and plants shall be submitted for inspection and stored on the site until furnishing of materials is completed. Photographs may be used for Plant Material if they include the following: date of image, person or object for scale, nursery name and contact info, multiple views of any items 24" or larger. Delivery may begin upon approval of samples and completed grow and kill period, or as directed by the Owner's Representative. Substitutions in any material will not be permitted unless presented during bidding and specifically approved in writing by the Owner's Representative in the form of an official bid addendum.

A. Soil and Soil Amendments:

1. Fertilizer and amendments for soil conditioning and maintenance shall bear the manufacturer's guaranteed analysis and shall be as recommended in the required soils laboratory report.
2. Fertilizer tablets if called for shall be Gro-Power 7 gram 12-8-8, to be applied per Manufacturer's Specifications.
3. Myco tabs if called for shall be TRI-C 1.68 gram Myco Tabs(Mycorrhizal + NPK) to be applied per Manufacturer's Specifications.
4. Myco Paks if called for shall be TRI-C 4 gram Myco Paks to be applied per Manufacturer's Specifications.
5. Premium Humate if called for shall be TRI-C premium humate applied per manufacturer's specification for soil preparation via Rototilling.
6. Revival Plus if called for shall be TRI-C Myco Revival plus and installed in conjunction with TRI-C humate per manufacturer's specifications.
7. Organic amendments if called for shall be nitrolized redwood sawdust (.5% actual nitrogen), or Fir Bark 1% nitrogen). It shall be fine textured, having minimum 80% passing #8 screen and minimum 95% passing #4 mesh screen. Salinity shall be no higher than 3.5 milliohms per centimeter at 25 Centigrade as measured by saturation Pine shall not be used as an organic amendment.

B. Application Rates

Application rates when called for shall be at a minimum as listed below - Note: Soil analysis may adjust listed rates and shall take precedence.

1. Fertilizer tablets- Apply 7 grams Gro-Power tablets at the following rates per plant by size:

Shrubs:

- 1 gal. shrub – 3 tablets
- 5 gal. shrub – 8 tablets
- 15 gal. & 24" box shrubs – 15 tablets

Ground Cover:

Apply one 7 gram Gro-Power tablet per rooted ground cover cutting/ 4" pot. Refer to Manufacturer's Specification for installation procedure.

Trees:

- 24" box tree – 16 tablets
- Larger sizes: For each 1/2" caliper measured 14" above soil level use 3 to 4 tablets.

2. Myco tabs shall be used at the following rates per plant by size:

· 1 gal - 2 tabs	48" box – 34 tabs
· 5 gal - 8 tabs	60" box – 40 tabs
· 15 gal – 16 tabs	72" box – 46 tabs
· 24" box – 22 tabs	84" box – 52 tabs
· 36" box – 28 tabs	96" box – 60 tabs

3. Myco Pak shall be used at the following rates per plant by size:

· 1 gal – 1 pak	24" box – 12 paks
· 5 gal – 3 paks	36" box – 18 paks
· 15 gal – 8 paks	48" box – 22 paks

4. Premium humate shall be incorporated at 50lbs. per 100 square feet**5. Myco Revival Plus shall be topically applied per manufacture and watered in accordance with the manufacturer's instructions****C. Inorganic Conditioners:**

Inorganic conditioners shall be agricultural grade gypsum, soil sulfur and iron sulphate. Iron sulphate shall be ferric sulphate or ferrous sulphate in pelleted or granular form containing not less than 18.5% iron, expressed as metallic iron, and shall be registered as an agricultural mineral with the State Department of Agriculture in compliance with Article 2 "Fertilizing Materials", Section 1030 of the Agriculture Code.

2.02 PLANTS

All plants shall be true to name, and one of each bundle or lot shall be tagged with the name and size of plants in accordance with the standards of practice recommended by American Standard for Nursery Stock ANSI Z60.1-2014. The root condition of plants furnished in containers shall be determined by removal of earth from the roots of not less than two plants nor more than 2% of the total number of plants of each species or variety except when container-grown plants are from several different sources: in which case, the roots of not less than two plants of each species or variety from each source shall be checked by the Owners Representative / Landscape Architect at his option. The selection of plants to be checked will be made by the Owners Representative / Landscape Architect. All plants rendered unsuitable for planting shall be considered as samples, and replacements shall be provided at no additional cost. In case the sample plants are found to be defective, the entire lot or lots of plants represented by the defective samples will be rejected.

- A. All trees and shrubs supplied by Contractor shall be of the specified standard height and diameter set by the American Standard for Nursery Stock. The height of the trees shall be measured from the root crown to the last division of the terminal leader and the diameter shall be measured six (6) inches above the crown roots. The trees shall stand erect without support.
- B. No plants or trees shall be accepted with compromised root systems, including girdling, root bound, and or recently up planted from smaller container stock.
- C.
- D. Container stock shall have grown in the container for at least 6 months, but not over two years.
- E. Do not prune any plants prior to delivery without specific prior approval.
- F. Material that has been trimmed, damaged, or does not meet the standard approved via photographs will be rejected.
- G. All cost associated with returning and replacing rejected material shall be the Contractor's sole responsibility.
- H. Substitutions shall not be permitted unless the contractor can prove in writing that no specimens can be located within 100 miles of the project. A minimum of 5 notices from suppliers stating the plant is not available are required.
- I. At all times plants shall come from Nursery stock grown in similar conditions and climate zones as associated with the project.

2.02 BACKFILL MATERIAL

- A. Topsoil shall be free from noxious weed seed and shall be of a loam characteristic, fertile and friable.
- B. Wood shavings shall be leached nitrogen fortified and shall be free of foreign matter.
- C. Soil used for backfill of planting pits for bidding purposes shall be enriched using the following blend per cubic yard (agronomic soil test recommendations shall take precedence where these minimum amounts are exceeded):
 - 60% site soil or
 - approved import 40%
 - wood shavings
 - 17 lbs. soil condition/fertilizer (Gro-Power Plus) 1 lb. iron sulphateAll plant pits shall be backfilled with backfill mix as specified above.
- D. All soil backfill shall be bulk mixed, not individually mixed at each plant pit.

2.03 STAKES AND TIES

- A. Tree stakes shall be 3" dia. x 10-foot-long straight-grained copper naphthenate treated lodgepole pine unless called for differently per the plans. Stakes shall be free from

knots, checks, splits, or disfigurement.

- B. Tree ties shall be "Cinch-Tie Tree Support" supplied by V.I.T. Co., Escondido, California, (760) 480-6702. For 5- 15-gallon trees, Model CT24; for 24"- 36" box trees, Model CT32. Total amount of ties per tree shall be as called for by the Details.
- C. Multi-stem trees and 48" box trees and larger shall require underground tree guying/earth anchors system that include strapping of the root ball and soil anchors. Duckbill Root Ball anchor sized per manufactures recommendations or approved substitution shall be required.
- D. Tall vertical growing specimens, similar to Italian Cypress or Brisbane Box trees shall require special staking requirements designed to align and support their long single leader growth habits. This shall include using 20' length sch. 40 steel pipe or similar staking devise that may require special installation and tie methods. Contractor to include alternative staking methods based on tree types as required by plans in the total cost of their bid.

PART 3 - EXECUTION

3.01 LANDSCAPE GRADING

- A. The Contractor shall complete preliminary grading as required by adding soil, removing surplus soil, removing rocks and debris over 1 inch in diameter within the top 2" of soil in flat and slope areas, and removing rocks over 2" in diameter within the top 6" of soil in areas with slopes less than 3:1. Bring all areas to be landscaped to finish grade. All areas shall slope to drain. Flow lines shall be established to drain inlets, existing road curbs, sidewalks, and or other drainage conveyance structures as shown on the grading plans. Contractor shall notify Owners Representative/ Landscape Architect of any areas that appear to have drainage issues prior to soil preparation for complete mitigation and or correction.
- B. The Contractor shall key/cut and remove all soil for mulch, ground cover, turf interfaces with hardscape per the details to retain minimum depth and final finish alignment.

3.02 WEED AND PEST CONTROL MEASURES

- A. Upon completion and acceptance of all fine grading work and prior to soil preparation, the Contractor shall perform weed control (Grow/Kill) measures as follows:
 - 1. Irrigate all areas designated to be planted for a minimum of 10 minutes per setting, two settings per day for 14 days continuously to germinate existing seed bank.
 - In instances of point source or drip irrigation it is the Contractors responsibility to completely irrigate all planting areas which may require additional or supplemental irrigation above the designed system per plans. This may include adding above ground temporary irrigation, watering from water trucks/tanks, and or hand watering

and shall be included in the Contractors bid.

2. Apply a contact non selective herbicide per the written recommendations of a Certified Pest Control Advisor specific to the site- allow 7 days or sufficient time to pass to allow a complete kill of all weeds germinated.
3. Remove all weeds present including any viable root systems and above ground vegetation.
4. Repeat step one for only 7 days and then follow steps 2-3 as above until weed cover is less than 1%.
5. Contractor to indicate on master schedule total grow kill period as part of submittals.
6. Contractor shall call for inspection and verification of the completion of the Grow Kill Period prior to planting.
7. If the Contractor wants to phase the grow kill operation, the Contractor will be responsible for providing plans documenting treatments including start and stop dates, in addition to reporting and requesting additional inspections for verification.
8. Any failure by the Contractor to continually irrigate or miss herbicide or clean up windows as listed above would require the process starting over from step one.
9. Contractor is responsible for the purchase and erection of all signs and barriers required to prevent intrusion into treated areas in addition to all required forms of public notice as required by the PCA responsible for the recommendation, local governing organizations, and or manufacture requirements for the safe and responsible use of products.
10. No material or method applied shall affect the success or ability of hydroseeded or planted material to germinate/thrive.
11. During grow and kill operations the Contractor shall also re-access any possible rodent or herbivore activity and continue removal and or treatment programs to maintain a pest free site and a boundary or buffer zone. This shall include areas outside of planting limits if within the project property to create buffer zones.

3.03 SOIL PREPARATION

- A. All fine grading and mounding and all weed control measures shall be documented, completed, and approved prior to any soil preparation.
- B. This work shall not commence until the agronomic soils tests have been completed. Should 30 calendar days elapse between completion of soil preparation and commencement of planting, all areas shall be prepared again.
- C. In planting areas with gradients less than 3:1, a layer of soil amendments shall be spread and rototilled into the soil to a minimum depth of 4 inches, or as required by the soils report, so that the soils shall be loose, friable, and free from all rocks, sticks, and other objects undesirable to planting.
- D. The following soil amendments shall be used for estimating purposes if soil tests are

not provided a time of bid and be added per 1,000 square feet to all planting areas with gradients less than 3:1 (agronomic soil test recommendations shall take precedence where these minimum amounts are exceeded). Contractor shall be responsible for any additional cost due to Soil report recommendations and shall have inspected and understood the current soil conditions at time of Bid. (Note: the following is for typical ornamental planting installation- they shall not apply to Native plantings, see Soil Management report for further information if included in plans)

1. 3 cubic yards organic amendment
2. 200 pounds soil conditioner/fertilizer (Gro-Power Plus)
3. 25 pounds gypsum

All landscape areas shall be re-fine graded to "dress out", maintain, and/or reestablish grades and flow lines as approved prior to amending the soil. Fine grades will be inspected upon completion. Contractor shall not proceed with planting work until fine grades have been inspected and accepted by the Landscape Architect

- E. Moisture Content - The soils shall not be worked when the moisture content is so great that excessive compaction will occur; and not when it is so dry that dust will form in the air or that clods will not break easy. Water shall be applied, as necessary, to provide ideal moisture content for tilling, planting, and required dust control.
- F. Note: Special soil preparation areas such as drainage basins or areas with different agronomic requirements shall be per plan and or notes/details.

3.04 FINISH GRADING

- A. After completion of all soil preparation work the Contractor shall finish grade all planting areas filling as needed or removing surplus dirt, removing rocks and debris over 1 inch in diameter, and floating to a smooth uniform grade. All areas shall slope to drain. Flow lines shall be established to inlets, road curbs and/or other drainage means as shown on the plans and as directed.

3.05 PLANTING

- A. Prior to planting the Contractor shall dig test planting holes for percolation tests. Per direction of the Landscape Architect, locations shall be selected to address all soil types and situations on site, such as examples for slope, exposure, soil type, etc. Holes will be dug to the depth per planting details and filled to 25% capacity with water. Test start time will be documented and checked every half hour until fully infiltrated to ensure proper drainage. Any areas found to not infiltrate per the recommended time frame will require additional drains and specialized planting techniques per the details for Trees and Shrubs in Wet Soils, which require deeper pits, additional gravel sumps, and drain pipes.
- B. Trees and Shrubs: Plant holes shall be dug to size as indicated in the drawings. Before trees and shrubs are set in the holes, all holes shall be pre-watered as follows:

All planting holes shall be filled to the brim with water and allowed to drain before any planting is done. If water does not drain out of hole within 24 hours, this fact must be brought to the attention of the Landscape Architect so that corrections can be made.

Correctional work shall not be considered an extra, as it will be the Contractors sole responsibility as part of soil preparations to remedy any localized soil issues.

- C. Soil surrounding planting pit shall be in a friable condition and moist to a depth of 8".
- D. Backfill using specified soil mix per the details to within 8" of finish grade. At this depth, place the fertilizer tablets or Mycro packs/ tabs per details. Complete backfilling to finish grade.
- E. Plants and Trees shall be planted at such a depth that the crown roots bear the same relative position to finish grade as they did to the soils where they were grown. At no time shall the soil level be raised around the crown. Backfill after planting shall be compacted carefully into place without injuring the roots of the tree or breaking up the ball of earth surrounding the roots.
- F. Contractor shall create and mound soil as required for water basins per the details including adding slope guards, stones for root cover/ soil moisture protection on southwestern exposures, trunk protection, and additional straw wattles when required.
- G. All excess soil spoils and excavated debris shall be removed from the site by the Contractor.

3.06 GROUND COVER AND VINE PLANTING

- A. Soil preparation and fine grading shall be completed prior to ground cover planting.
- B. Mulch and fertilize ground cover areas per Section 3.03, part D. of planting specifications.
- C. All rooted ground cover and bare dirt areas are to be treated with a pre-emergent chemical (subject to approval by the Landscape Architect prior to application). Chemicals are to be applied by a DPR Qualified or Certified applicator. This treatment shall be applied at the following times during the contract: a) before planting, b) at beginning of plant establishment period, and c) at the end of plant establishment period. The Owners Representative / Landscape Architect shall be given a minimum of 48 hours (2 working days) notice prior to each application. No chemicals shall be applied other than in the presence of the inspector.
- D. Ground cover shall be planted below all shrubs and trees to within 12" of the shrub main stem unless otherwise noted on the plans.
- E. Ground cover and vines shall be planted in moist soil and spaced as indicated on the plans.
- F. Each plant shall be planted with its proportionate amount of flat soil to minimize root disturbance. Soil moisture shall be such that the soil does not crumble when removing plants.
- G. Following planting, ground cover and vine areas shall be regraded to restore smooth finish grade and to ensure proper surface drainage. All excess soil spoils and excavated debris shall be removed from the site by the Contractor.
- H. A 3-inch layer of mulch per plans shall be spread over the planted areas. Watering shall begin immediately following mulching.
- I. When necessary to prevent plant damage from pedestrian traffic during the initial growing stage, the Contractor shall erect temporary protective fencing to be removed at the end of the plant establishment period.

- J. Vines shall be tied to walls, fences, etc., in the manner prescribed on the plans. Temporary staking shall be removed at the beginning of the plant establishment period.

3.07 TREE STAKING

- A. Stake trees as per planting details. No bare metal wire shall circle any part of any tree.
- B. All nursery stakes shall be removed at the time of planting.
- C. Contractor to adjust staking as needed for locations in high wind areas, including adding more restraints and stakes per the plans and current ISA guidelines at no additional cost.

3.08 WATERING

- A. It shall be the Contractor's responsibility to maintain a balanced watering program to ensure proper growth until final acceptance of the work.
- B. Immediately after planting, apply water to each tree, shrub or vine. Apply water using a gentle spray pattern via a water wand in the planting hole until the material about the roots is completely saturated from the bottom of the hole to the top of the ground.
- C. Apply water in sufficient quantities and as often as seasonal conditions require to keep the planted areas moist at all times per the plants requirements, well below the root system of plants.
- D. For hydroseed installation using Eco Mat or other subsurface irrigation the contractor will be responsible for any head adjustments or hand watering required to germinate the seeds against any hardscape buffer areas (typically 24") at no additional cost.
- E. Irrigation:
 - 1. Contractor shall properly and completely maintain the irrigation system. Contractor to program controller per watering schedule on irrigation plans and adjust in the field as necessary. Overhead irrigation areas to have a maximum run time of 15 minutes per cycle with additional cycles as needed. At no time will run off or erosion be allowed.

3.09 MULCHING

- A. Contractor to apply a 3" minimum mulch layer to all planting areas unless specified as other ground cover treatment by the plans.
- B. Contractor to keep mulch from plant trunks as follows:
 - 1. Shrubs shall have 3" of clearance from trunks/main stems to mulch
 - 2. Trees shall have 6" of clearance from crown/ base of the flare to mulch

3.10 PLANT PROTECTION

- A. The Contractor is responsible for all aspects of protection of the installed landscape from loss or damage through the Plant Establishment and Maintenance periods until the final acceptance via written notice. This shall include any additional materials or protection methodologies such as but not

limited to ground wire cages, shields, trunk covers, shading, herbivore protection above/below via product use or trapping and or removal, application of deterrents, and Pest and Insect control.

3.11 PRUNING

- A. All shrubs and trees shall be pinch pruned as necessary to encourage new growth and to eliminate rank sucker growth. Old flowers, and dead foliage and limbs shall be removed. No major pruning shall be done without the approval of the L.A. Any damage to shrubs and trees that drastically changes structure and or appearance shall require the Contractor to replace in kind with an approved replacement at no additional cost per the direction of the Landscape Architect.

3.10 MAINTENANCE

- A. All areas landscaped by Contractor under this contract shall be maintained by said Contractor for a minimum plant establishment period of not less than ninety (90) days or as called for by the Contract documents from the date of written acceptance of initial installation and substantial completion per the requirements of the plans, specifications, and contract documents.

3.11 START OF PLANT ESTABLISHMENT

- A. Criteria for start of plant establishment period:
 - 1. The plant establishment period shall not start until all elements of the project that impact the landscape are completed in accordance with the contract documents. Projects will not be segmented into phases.
 - 2. Permanent Water and Power to remote controllers shall be established.
 - 3. Fully automatic irrigation including acceptance of installation and as-builts/controller charts.
 - 4. Written acceptance of the Owners Representative must be obtained prior to the start of the plant establishment period.
 - 5. If the project maintenance fails to continuously meet standards required, the plant establishment period "day count" will be suspended and will not recommence until Contractor has corrected all deficiencies.
 - 6. The 90-day establishment period is the minimum required and will be extended as needed at no additional cost to remedy issues and bring the project into compliance.

3.12 LANDSCAPE MAINTENANCE (PLANT ESTABLISHMENT)

- A. Refer to section 32 90 05 Landscape Maintenance

3.13 CLEAN UP

- A. Upon completion of the work, the Contractor shall smooth all ground surfaces; remove excess materials, rubbish, debris, etc.; sweep adjacent streets, curbs, gutters, walkways, and trails; and remove construction equipment from the premises.

- B. This shall include power washing all hardscape, site structures, site furnishings to return them to a state of clean and unsoiled. If the finish has been soiled past the ability to be washed off the Contractor shall be responsible to returning it to a new finish state, including repainting, refinishing, and in extreme cases replacing in whole.

END OF SECTION

SECTION 32 90 05
LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Furnishing and implementing a complete landscape maintenance program to maintain all planting areas from time of Accepted plant installation through the (90) ninety-day or per contract document Plant Establishment Period and accepted Final Completion. Contractor shall note the (90) ninety-day period is the minimum for plant establishment and that failures of plant performance/establishment and or Contractor failures to properly meet all requirements shall extend the period as deemed necessary by the Owner's Representative.

1.02 SCOPE OF WORK

- A. Furnish all supervision, labor, materials, equipment and transportation required to maintain the landscape in a thriving condition as it establishes and take root, as specified herein.
1. Care of all lawn and ground cover areas if present, including watering, cutting, edging, trimming, fertilizing and pest control within all ground cover areas as directed herein.
 2. Care of all shrubs, trees, and groundcover areas, including watering, cultivation, pruning, fertilization, debris removal, and pest control including but not limited to:
 - a. All cultivation and soil aeration as necessary to maintain optimum conditions for plant growth.
 - b. Fertilization of all plant material on a regular schedule, including soil testing as necessary to determine requirements and application methods with reference to the project soil analysis.
 - c. All pruning, re-staking, tightening or adjustment of guy wires or straps and trimming of plant material that is required in landscape areas to promote growth and proper structure.
 - d. Control and/or prevention of diseases, insect and or rodent infestation using methods and techniques approved by State Licensing Agency.
 3. Supplemental watering of plant material on a regular basis through use of automatic irrigation systems and/or hand watering as needed, while consistently monitoring and adjusting water needs to maintain optimum conditions for plant growth per each species/hydrozones requirements.
 4. Maintenance of irrigation systems, including adjustment of heads and valves and regular controller program updating, cleaning of filters, and fertilizer injection systems if included per plans.
 5. General maintenance of the site and associated amenities including removal of litter and debris, cleaning of site features, graffiti removal, and reapplication of any anti-graffiti coatings as required.
 6. Replacement of plantings, or other materials, that, in the Owner's Representatives opinion, require replacement due to failure, decline or the Contractor's neglect in care or maintenance at no cost to owner.

7. Protection of Property and Landscape During Inclement Weather: During periods of inclement weather, Contractor shall provide supervisory inspections of the project during regular hours to prevent or minimize possible damage from storms or weather events. Contractor shall report any storm damage to Owner's Representative.
 8. Protection of Existing Facilities and Structures: Contractor shall exercise due care in protecting from damage all existing facilities, structures, and utilities both above and below grade from maintenance activities- any damage from equipment or personnel shall be repaired or replaced immediately to the original condition of a new installation.
 9. Project Inspection: Contractor will meet with Owners Representative per approved schedule to verify compliance with specifications. Following each meeting, Contractor will submit written reports noting problems cited during inspections and any actions taken.
 10. Work Schedule: A monthly schedule shall be prepared and submitted to the Owner prior to the beginning of each month. Schedules shall indicate times, days of the week and type of work to be performed including manpower for approval.
- B. Section also includes notification and coordination with the Recreation & Park Department if present prior to completion of the Plant Maintenance Period.

1.03 RELATED WORK

- A. Section 32 84 00 – Planting Irrigation
- B. Section 32 90 00 – Planting

1.04 REFERENCE STANDARDS

- A. Plant Material Standards: "American Standard for Nursery Stock", current edition, American Association of Nurserymen.
- B. Staking and Guying Procedures: "Staking Landscape Trees", University of California Extension Publication #2576.
- C. Pruning Procedures: "Pruning Landscape Trees", University of California Extension Publication #2574.
- D. ISA standards and BMP

1.05 WORK FORCE

- A. Supervision: Contractor shall furnish competent supervisors, to be present on the job site at all times during which work is being performed. Supervisors must possess adequate technical background, preferably with formal education in ornamental horticulture. Supervisors must be English speaking and preferably bilingual (in Spanish) if crews are Spanish speaking.
- B. General Personnel: In addition to Supervisors, Contractor shall supply sufficient working personnel capable of promptly accomplishing, on schedule, all work required under this contract during regular hours.
- C. All such personnel shall be physically able to perform their assigned work. The Contractor and his employees shall conduct themselves in a proper and efficient manner at all times and shall cause the least possible annoyance to the public. They shall be fully clothed in uniforms and suitable attire. All maintenance staff shall have ID badges and the current PPE as required by OSHA. The Owner may require the Contractor to remove from the work site any employee(s)

deemed careless, incompetent, or otherwise objectionable, whose continued employment on the job is considered to be contrary to the best interest of the Owner. All personnel shall be U.S. citizens or legal residents.

1.06 WARRANTY

- A. Refer to Section 32 90 00 – Planting.

1.07 SCHEDULE

- A. Submit a proposed maintenance work schedule to the Owner's Representative in writing for review at least 10 days prior to commencement of maintenance work. All maintenance work shall be done at times approved by the Owner's Representative so as not to conflict with the operation of the project.
- B. Project site must be visited twice weekly for the first (30) days and once weekly as a minimum thereafter until the end on establishment.
- C. For Projects with extended maintenance periods over 90 days see below for a reference of general required activities.

Frequency Per Month:

Operation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Site Check	4	4	4	4	4	4	4	4	4	4	4	4
Debris Removal	2	2	3	3	4	4	4	4	3	3	2	2
Pruning	0	1	0	0	0	0	0	0	0	1	0	0
Weed Control	0	2	3	3	4	4	4	4	3	2	2	0
Clean + Sweep	2	2	3	3	4	4	4	4	4	4	2	2
Irrigation Adjustment	1	1	1	1	2	2	2	2	2	1	1	1

1.08 TECHNICAL SPECIFICATIONS

- A. Turf-Mow-Edge

1. Mowing

- a. All turf areas shall be mowed once per week at a minimum- adjustments to mowing's per week may be directed dependent on turf and season.

- b. Work shall be performed on the same day each week. Initial week schedule and any changes must be approved by the Owner prior to implementation.
- c. Mowing's missed visits due to inclement weather or ground conditions from such weather shall be rescheduled and completed within 3 work days on weekly schedule and within 7 days on bi-weekly schedule.
- d. Cutting heights shall be adjusted according to the type of grass in accordance with the following:

TURF TYPE	TIME OF YEAR	CUT HEIGHT
Bluegrass and Fescue	June through September	3"
Bluegrass and Fescue	September through May	2"
St. Augustine	Year-Round	2-1/4"
Bermuda	Year-Round	3/4"
Buffalo Grass	Year-Round	1-1/2"

- e. All warm season grasses to include Bermuda, Buffalo and St. Augustine shall be mowed with a power-driven reel type mower. Bluegrass and Fescue may be mowed with either power-driven reel type or rotary type mowers. All equipment shall be adjusted to the proper cutting heights and shall be adequately sharpened.
 - f. All visible grass clippings shall be collected and removed from the site prior to the completion of that day's mowing operations or the end of the day, whichever occurs first.
 - g. All trash, leaves, paper and other debris shall be removed and disposed of off-site prior to mowing.
 - h. All walkways, roadways, trails or other areas dirtied by mowing operations shall be cleaned and all debris disposed of off-site prior to the completion of that day's mowing operations or the end of the day, whichever occurs first.
2. Edging
- a. All turf grass borders shall be neatly and uniformly edged or trimmed concurrent with every mowing with bladed tools- no string trimmers will be allowed for edging.
3. Turf Maintenance
- a. All turf areas shall be irrigated as required to maintain adequate growth and appearance.
 - b. Contractor shall monitor the requirements of the plant material, soil conditions, seasonal temperature variations, wind conditions and rainfall and shall recommend appropriate changes in duration of watering cycles. No actual changes will be implemented without prior approval of the Owner.
 - c. Special areas of consideration:
 - 1) Special irrigation zones may exist such as, sub irrigation zones for turf adjacent to hardscape. In some situations, for example in hydroseeded applications, the Contractor shall hand water as required for initial germination and establishment as part of the installation and establishment period if deemed

necessary. This will be included with the contract price and no additional cost or charges will be allowed.

4. Weed Control

- a. A regular program of approved chemical application shall be used to control weed growth, supplemented by hand removal of noxious weeds or grasses as necessary.
- b. In areas of native planting, hand removal may be the only method allowed.

5. Fertilization

- a. All turf areas shall be fertilized in accordance with soils report, specific turf requirements and or recommendations when granular fertilization is used; if no soils report exists, the following criteria shall prevail.

TURF	FORMULA	RATE	CYCLE
Bluegrass	16-6-8 w/trace elements	1 lb. actual nitrogen/ 1,000 S.F.	45 days
Bermuda	Ammonia Nitrate 33.5-0-0 16-6-8 w/trace elements	1 lb. actual nitrogen/ 1,000 S.F.	45 days
Fescue	16-6-8 w/trace elements	1 lb. actual nitrogen/ 1,000 S.F.	45 days
St. Augustine	Ammonia Nitrate 33.5-0-0	1 lb. actual nitrogen/ 1,000 S.F.	45 days
Buffalo grass	Manufacture approved crab grass preventer	Per manufacturer	45 days

B. Fallen Vegetation and Debris Removal

1. The contractor shall police the entire project area including all paved areas, planters, lawn areas, sidewalks (including common area sidewalks) and trash enclosures and collect fallen leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks, and any and all other debris to prevent unsightly and inordinate accumulations during normal maintenance working hours. Sidewalks shall be swept or washed as necessary to keep free of trash and graffiti. Collected items shall be promptly removed and taken to a legal disposal site.

C. Removal of Dead Animals or animal waste

1. Removal and legal disposal of animal carcasses and animal waste are considered a normal maintenance task for the duration of the maintenance period. Dead carcasses shall be legally removed immediately when discovered by the contractor. For areas that include dog parks all animal waste shall be immediately removed once discovered by the contractor.

D. Erosion Control

1. Any installed erosion control measures such as straw wattles, silt fences, sand/gravel bags, etc. are to be continually maintained throughout the project by the Contractor. This shall

- include sediment/soil removal and replacement, BMP maintenance and replacement to due to damage, failure, or end of life.
2. The contractor is responsible for daily visual inspection of landscape areas and slopes and immediately reporting areas experiencing erosion to the landscape architect and/or owner's representative on the same day noticed. If the contractor fails to notify the landscape architect and/or owner's representative of areas experiencing erosion on the same day noticed, then the contractor assumes full responsibility for any erosion control measures and/or repairs as directed by the landscape architect and/or owner's representative at no additional cost to the owner.
 3. The contractor is responsible for immediately repairing and correcting any progressive rilling that may occur.
 4. Erosion control measures may include but not be limited to:
 - a. Filling
 - b. Raking
 - c. Redirecting runoff
 - d. Properly programming irrigation operations
 - e. Replanting
 - f. Replacing mulch
 - g. Providing additional erosion control materials such as:
 - 1) Jute matting
 - 2) Filter Fabric
 - 3) Hay bales
 - 4) Hay rolls
 - 5) Silt fencing
 - 6) Sand Bags
 - 7) And/or other erosion control items as required to maintain healthy plant material and stable slopes.
 - E. Additional erosion control measures required due to irrigation operations programmed by the contractor that did not take into account cycle and soak functions of the controller will be installed and/or repaired as directed by the landscape architect and/or owner's representative at no additional cost to the owner.
 - F. Mulch replenishment
 1. Contractor to replenish mulch levels as required to match installation levels with the same type as listed in the documents

1.09 PROTECTION

- A. Maintain all planting areas from time of plant installation, through the Plant Establishment Period and final acceptance, in accordance with Standard Specifications.
- B. Maintain weed levels to less than 5% of total area with a final goal of less than 3% at completion of the establishment period.
- C. Maintenance also includes temporary fences, barriers, and signs as required for protection.
- D. The Contractor shall treat or replace any plant that becomes damaged, fall in decline or be injured, as directed by the Owner's Representative at no additional cost to the Owner.

- E. The Contractor shall be responsible for protecting the health and function of the soil including;
 - 1. Maintaining mulch cover
 - a. Using powered blowers in mulched areas is prohibited.
 - 2. Stripping soil cover and exposing soil is prohibited.
 - 3. Allowing soil to dry out or over watering causing an anaerobic conditions.
 - 4. Compaction of soil due to equipment is prohibited.

If any of the above issues develop or occur during the maintenance period the contractor shall be responsible to correct in full at no cost to the owner, this shall include soil tillage, de-compaction, adding additional amendments, replacing mulch, and removal and replacement of damage soil if mitigation is not feasible.

1.10 FERTILIZATION

- A. Groundcover and all planting shall be fertilized in accordance with soils report recommendations when granular fertilization is used; if no soils report exists, the following criteria shall prevail: apply certified organic compost mulch at the rate of 3 cu yards per 1000 square feet 30 days after installation. Repeat application every 60 days if maintenance period is longer than 90 days. Organic Compost shall be Custom Amendment Mix (WCP 33) by Earthworks Soil Amendments, Inc., 951-782-0260.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Perform Site Observations: For the purpose of establishing the 90-day Maintenance Period and observing completion of the work of this Section through final acceptance. A minimum of (6) six separate field visits, occurring chronologically as follows:
 - 1. Observation for Maintenance at Commencement
 - 2. 15-day Progress Maintenance Observation
 - 3. 30-day Progress Maintenance Observation
 - 4. 60-day Coordinate Site Meeting with Client's Site Maintenance Staff
 - 5. 60-day Progress Maintenance Observation
 - 6. 90-day Observation for Final Acceptance
- B. Observation for Plant Establishment Period Commencement: Request observation and acceptance by Owner's Representative after all plant material is installed and after all irrigation work and other work of this Section is completed. Plant Establishment Period shall begin upon acceptance of final planting and review by the Owner's Representative. The Period shall continue for a minimum of 90-calendar days until Final Acceptance.

- C. At any time, deficiencies are found such as underperforming plants or a lack of maintenance, the Owner's Representative will notify the Contractor immediately that the 90-day period has been suspended until such time as the deficiencies are fully corrected.
- D. The Contractor has 3 days to respond to any notices of deficiencies and make appropriate corrections including plant replacements.

3.02 PROGRESS MAINTENANCE OBSERVATION

- A. General: Notify the Owner's Representative 72 hours prior to a required scheduled Progress Maintenance Observation. All items determined to be deficient during the previous observation shall be completed prior to the meeting. FAILURE TO DO SO MAY RESULT IN AN EXTENSION OF THE PLANT ESTABLISHMENT and MAINTENANCE PERIOD. In addition, prior to first Progress Maintenance observation, furnish the Owner's Representative with the following information:
 - 1. An "As-Built" irrigation plan, as specified.
 - 2. All supplier invoices for the nursery stock, commercial fertilizers, soil amendments, mulches and herbicides as shown and specified and as installed.
 - 3. Maintenance schedule for fertilization, irrigation, and for all planting areas.
- B. Failure to provide the above submittals may result in the re-scheduling of the Progress Maintenance Observations and extend the Maintenance Period.
- C. Notify the Owner's Representative in writing, prior to any of the Progress Maintenance Observations of any conditions, which may impede proper plant establishment and or growth.
- D. Final Maintenance Observation: Notify the Owner's Representative at least 7 days before the expiration of the Plant Establishment Period for Final Maintenance Observation. Prior to this observation, all items determined to be deficient during the Progress Maintenance Observations shall be completed and signed-off by the Owner's Representative.

3.03 FINAL COMPLETION

- A. General: Work under this Section will be accepted by the Owner's Representative upon satisfactory completion of all work of this Section, Section 32 90 00 Planting, and Section 32 84 00 Planting Irrigation, including 90-Day Plant Establishment Period, exclusive of replacement of plant material under the terms of the Warranty.
- B. Termination of Observation: During any Observations, any landscape item previously identified as deficient in the Progress Maintenance Observations and determined by the Owner's Representative to be still deficient, shall automatically terminate the Final Completion and result in the extension of the Plant Establishment Period an additional 30 days. Additional costs associated with subsequent Observations that are a result of the Contractor's failure to correct deficient items shall be paid by the Contractor. There shall be no conditional final completion agreement for any work.

3.04 NOTIFICATION TO OWNER FOR TRANSFER OF MAINTENANCE

- A. At least one month prior to the end of the 90-Day "Plant Establishment Period," the Contractor shall notify the Owner's Representative to coordinate a meeting between the Recreation & Park Department staff and the Contractor to ensure a smooth transition for turn-over of plant maintenance.

END OF SECTION

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS

EXHIBIT “A” – GEOTECHNICAL REPORT

for

**FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13**



GEOTECHNICAL INVESTIGATION

PROPOSED STRUCTURES
GYM & GARAGE WITH STORAGE
FIRE STATION 73
27415 ENTERPRISE CIRCLE
TEMECULA, CALIFORNIA

FEBRUARY 20, 2024
PROJECT NO. T2652-22-20

PREPARED FOR:
City of Temecula
41000 Main Street
Temecula, California



Project No. T2652-22-20
February 20, 2024

City of Temecula
41000 Main Street
Temecula, CA 92590

Subject: GEOTECHNICAL INVESTIGATION
PROPOSED STRUCTURES - GYM & GARAGE WITH STORAGE
FIRE STATION 73
27415 ENTERPRISE CIRCLE
TEMECULA, CALIFORNIA

Ms. Bennetts,

In accordance with your authorization of Geocon's Proposal IE-5122, dated November 7, 2023, and our work order, dated December 21, 2023, we have performed a geotechnical investigation for the proposed new structures consisting of a gym and a garage with storage at the City of Temecula Fire Station 73 located at 27415 Enterprise Circle in Temecula, California. The accompanying report presents the results of our geotechnical study and our conclusions and recommendations pertaining to the geotechnical aspects of the project. Based on the results of our investigation, it is our opinion that the improvements can be constructed as proposed, provided the recommendations in this report are followed and implemented during design and construction.

Should you have questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.



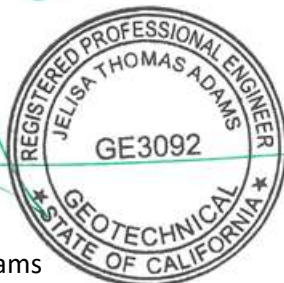
Ashleigh Love
PE 79019



Lisa A. Battiato
CEG 2316



Jelisa Thomas Adams
GE 3092



ADL:LAB:JTA
(email) Addressee

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our geotechnical investigation for the proposed new structures consisting of a gym and a garage with storage at the City of Temecula Fire Station 73 located at 27415 Enterprise Circle in Temecula, California (see *Vicinity Map*, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction.

The scope of this investigation included a review of previous geotechnical reports, site reconnaissance, field exploration, percolation testing, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on January 8, 2024, by excavating eight 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to depths between 5 and 51.5 feet beneath the ground surface. Percolation testing was performed on January 9, 2024, to determine the infiltration rate of site soils. The approximate locations of the exploratory borings and percolation tests are depicted on the *Geologic Map*, Figure 2. A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the List of References section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The site is located at 27415 Enterprise Circle in Temecula, Riverside County, California. At the time of our field investigation the site was occupied by a single-story, 6,819 square foot fire station building with attached garage, Portland cement concrete (PCC) paved parking areas and driveways, storage containers, a PCC trash enclosure, and a PCC hose drying ramp. The site is bounded by a chain link fence with commercial buildings and associated parking and driveways to the southeast and northwest, Enterprise Circle West to the northeast, and Murrieta Creek to the southwest. The Murrieta Creek embankment is approximately 50 feet south of the proposed new garage and is about 14 feet high with a 7:1 inclination (horizontal to vertical). The site is about 3-feet higher in elevation along its southwestern boundary at an elevation of 1028 feet above mean sea level (MSL) with the existing building elevations at about 1025 feet MSL. The latitude and longitude of the site are approximately 33.515604 degrees and -117.167319 degrees, respectively.

Based on plans prepared by TR Design Group, Inc. (12/15/2023), it is our understanding that the proposed additions will consist of demolishing the existing curbs and pavement and constructing a new apparatus bay with attached storage/shop, and a new gym building. Proposed minor structures include new light standards, a trash enclosure, a fuel dispenser on a concrete pad, and a new concrete slab/ramp for hose drying. The area of the proposed apparatus bay and storage/shop is currently occupied by paved and dirt parking areas. The area of the proposed gym building is currently occupied by paved driveway and a landscaped planter. Plans depicting the proposed improvements are provided on the Site Plan (see Figure 3). Based on information provided by the project structural engineer, wall loads for both proposed structures will be up to 2.3 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Changes in the design, location or elevation of structures, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is located within the Temecula Valley area of the Elsinore Trough within the Peninsular Ranges Geomorphic Province. The Peninsular Ranges are bounded on the north by the Transverse Ranges and the Cucamonga/Sierra Madre faults, the east by the San Jacinto fault, the west by the Elsinore fault and the Santa Ana Mountains. The Province extends southward into Mexico. The Peninsular Ranges are characterized by granitic highlands of low to moderate relief surrounded by alluvial plains and valleys. Locally, the Temecula Valley is bounded by the Wildomar and Willard branches of the Elsinore Fault system. We encountered previously placed artificial fill and Young Alluvial Valley Deposits (Qyv_a) underlying the site to depths of at least 51½ feet. No faults or landslides were geologically mapped on the site by Kennedy (1977), Kennedy & Morton (2003) or Dibblee (2008). The Regional geology is depicted below on a portion of the 2003 Preliminary Geologic Map of the Murrieta Quadrangle.

ACTIVE FAULTS WITHIN 50 MILES OF THE SITE



4. SOIL AND GEOLOGIC CONDITIONS

We encountered previously placed artificial fill underlain by young alluvial valley deposits to the maximum depth explored of 51½ feet below ground surface. Geologic unit classification follows that of Kennedy & Morton, 2003. The descriptions of the soil and geologic conditions are depicted on the *Geologic Map*, Figure 2, discussed on the boring logs in detail, and generally described below.

4.1 Artificial Fill (af)

Artificial fill was encountered in our explorations to depths of up to 10 feet below existing ground surface. The fill generally consists of dark brown and grayish brown silty sand and sandy silt with traces of clay that can be characterized as moist and loose to medium dense, or soft to stiff. The fill encountered in B-4 is loose, possibly due to disturbance during the construction of the previous fire station addition. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Young Alluvial Valley Deposits (Qyv_a)

Young Alluvial Valley Deposits were encountered at the ground surface in the western area of the site and below the undocumented artificial fill within the developed area of the site. The alluvium consists of dark brown to grayish brown sandy silts with traces of clay and silty sands and can be characterized as moist and loose to medium dense, or soft to very stiff. Alluvium likely underlies the site to depths of several tens to more than 100 feet. Consolidation test results indicate that most of the upper 10 feet of soils are moderately to highly compressible.

5. GROUNDWATER

We encountered static groundwater during our investigation at depths between approximately 12.5 and 20.5 feet below ground surface. Department of Water Resources groundwater level reports indicate groundwater depths near the site have been measured at 10 feet below ground surface (water surface elevation of 1029.32 feet MSL, Well 07S03W35K001S) and 25 feet below ground surface (988.33 feet MSL, Well 07S03W35P002S) in the past. It is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed (especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall), groundwater seepage levels encountered during construction may be actually higher than those encountered during our investigation. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the region. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the *Surface Drainage* section of this report.

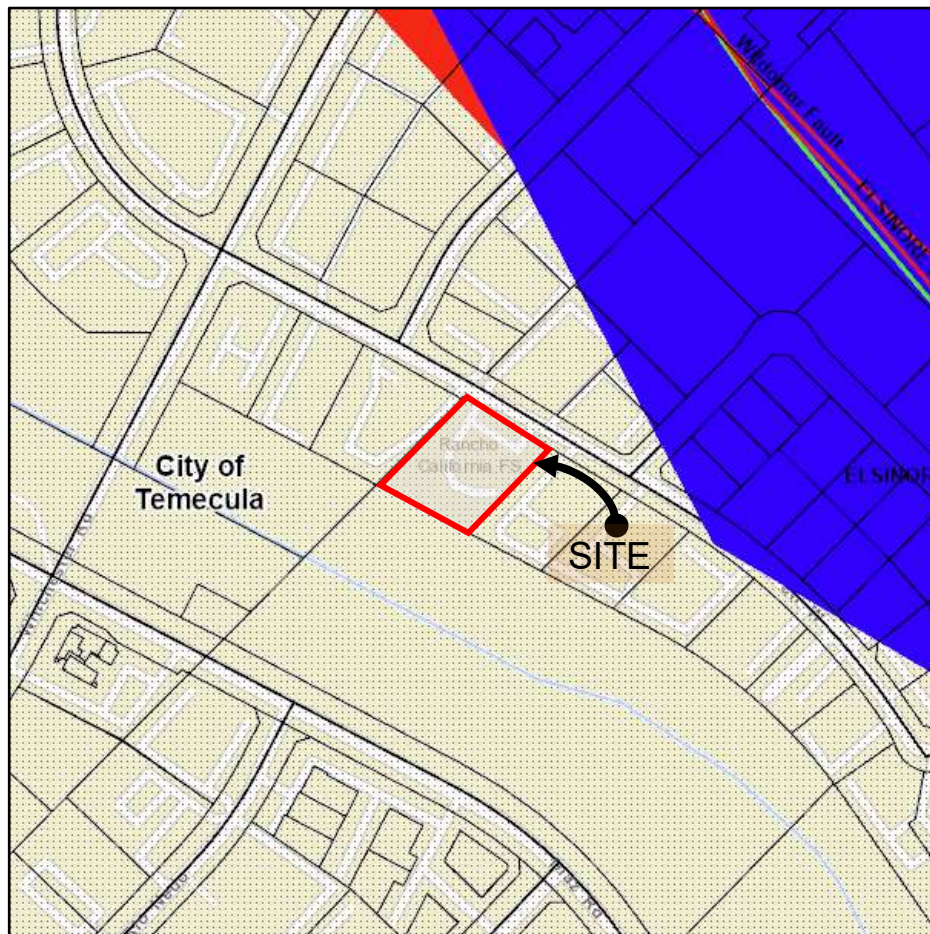
6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in southern California include active, potentially active, and inactive faults. The criteria for these major groups are based on data developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (Bryant and Hart, 2007). An active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A potentially active fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not located in a Riverside County or State of California Fault Hazard Zone (Map My County). Faults are not geologically mapped within or projecting toward the site (Kennedy et al, 2003). The site with respect to fault hazard zones and mapped faults is depicted below (Map My County).

SITE FAULT HAZARD ZONES



6.2 Seismicity

As with all of southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. Faults within a 50-mile radius of the site are listed in Table 6.2A. Historic earthquakes in southern California of magnitude 6.0 and greater, their magnitude, distance, and direction from the site are listed in Table 6.2B.

TABLE 6.2A
ACTIVE FAULTS WITHIN 50 MILES OF THE SITE

Fault Name	Maximum Magnitude (Mw)	Geometry (Slip Character)	Slip Rate (mm/yr)	Distance from Site (mi)	Direction from Site
Wildomar	6.8	RL-SS	5	900 ft	NE
Murrieta Creek	Unknown	NORMAL	Unknown	1/3	SW
Glen Ivy North	6.8	RL-SS	5	7	NW
Casa Loma	6.9	RL-SS	12	20	NE
Clark	7.2	RL-SS	12	22	NE
San Jacinto Valley	6.9	RL-SS	12	29	NE
Rose Canyon	7.2	RL-SS	1.5	30	SW
San Geronio	7	THRUST	n/a	31	NE
Chino	6.7	RL-R-O	1	31	NW
Newport-Inglewood	7.1	RL-SS	1.5	32	SW
Whittier	6.8	RL-R-O	2.5	37	NW
Coyote Creek	6.6	RL-SS	4	39	SE
San Andreas San Bernardino	7.5	RL-SS	24	40	N
Glen Helen	6.7	RL-SS	12	40	N
San Andreas South	7.5	RL-SS	24	43	NE
Cucamonga	6.9	R	5	47	N

Geometry: BT = blind thrust, LL = left lateral, N = normal, O = oblique, R = reverse, RL = right lateral, SS = strike slip.

Information Sources: a = Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, including Appendices A, B, and C, dated June; b = online Fault Activity Map of California website, maps.conservation.ca.gov/cgs/fam/, as of 1/2017.

n/a = data not available

TABLE 6.2B
HISTORIC EARTHQUAKE EVENTS WITH RESPECT OT THE SITE

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	34	N
Long Beach	March 10, 1933	6.4	46	W
Tehachapi	July 21, 1952	7.5	147	NW
San Fernando	February 9, 1971	6.6	94	NW
Whittier Narrows	October 1, 1987	5.9	64	NW
Sierra Madre	June 28, 1991	5.8	70	NW
Landers	June 28, 1992	7.3	63	NE
Big Bear	June 28, 1992	6.4	51	NNE
Northridge	January 17, 1994	6.7	92	WNW
Hector Mine	October 16, 1999	7.1	91	NE
Ridgecrest China Lake Fault	July 5, 2019	7.1	157	NNW

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *Seismic Design Maps*, provided by OSHPD. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCE_R).

Although there are liquefiable soils underlying the site, given the proposed single-story construction we expect the buildings will posses fundamental periods of less than 0.5 seconds; therefore, a site response analysis is not anticipated to be required in accordance with ASCE 7-16, Section 20.3.1.

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	E	Section 1613.2.2
MCE _R Ground Motion Spectral Response Acceleration – Class B (short), S_s	1.581g	Figure 1613.2.1(1)
MCE _R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.590g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.20	Table 1613.2.3(1)
Site Coefficient, F_V	2.02	Table 1613.2.3(2)
Site Class Modified MCE _R Spectral Response Acceleration (short), S_{MS}	1.898g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE _R Spectral Response Acceleration – (1 sec), S_{M1}	1.192*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.265g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.794*	Section 1613.2.4 (Eqn 16-23)
*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class “E” sites with short-period spectral accelerations (S_s) greater than or equal to 1.0 or with 1-second spectral acceleration (S_1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that the GMHA may be waived provided that either (1) where the equivalent lateral force procedure is used for design and the value of C_s is determined by Eq. (12.8-2) for all values of T, or (2) where (i) the value of S_{ai} is determined by Eq. (15.7-7) for all values of T_i and (ii) the value of the parameter SD_1 is replaced with $1.5SD_1$ in Eq. (15.7-10) and Eq. (15.7-11). The value of SD_1 presented above has not been modified in accordance with Supplement 3 of ASCE 7-16.		

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE _G Peak Ground Acceleration, PGA	0.707g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE _G Peak Ground Acceleration, PGA_M	0.778g	Section 11.8.3 (Eqn 11.8-1)

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the mean MCE peak ground acceleration is characterized as a 6.88 magnitude event occurring at a hypocentral distance of 8.08 kilometers from the site (based on a site class D/E boundary).

Conformance to the criteria in the above tables for seismic design does not constitute a guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the “Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California” and “Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California” requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

According to the Riverside County Information Technology Map My County GIS system, the site is located within an area mapped as having a “very high” potential for liquefaction. The *Temecula General Plan, Public Safety Element* (City of Temecula, 2005) also indicates the site is in a liquefaction zone.

We performed a liquefaction analysis of the soils underlying the site using the 1996 NCEER method of analysis with the updates by Youd et al. (2001). The liquefaction potential evaluation was performed by utilizing a historical ground water depth of 10-feet, a magnitude 6.88 earthquake, and the site-specific modified MCE_G peak ground acceleration (PGA_M) of 0.778. This semi-empirical method is based on a correlation between values of Standard Penetration Test (SPT) resistance. An average conversion factor of 0.63 was used to derive SPT blow-count values from California Modified Sampler blow-count values.

The enclosed liquefaction analyses, included herein for Boring B-1, indicates that the alluvial soils below the groundwater table could be susceptible to approximately 7.2 inches of total settlement during an MCE ground motion event. A summary of the estimated liquefaction induced settlements, calculations and output from our analysis are provided in Appendix C.

6.5 Lateral Spreading

Lateral spreading of a ground surface during an earthquake takes place along weak shear zones that have formed within a liquefiable soil layer toward an open slope face. Current understanding within the geotechnical engineering profession is that lateral spreading can be expected in liquefiable sites adjacent to slopes. Factors controlling lateral displacement include earthquake magnitude, distance from the earthquake epicenter, thickness of liquefiable soil layer, grain size characteristics, fines content of the soil and SPT blow counts. Bartlett and Youd (1995) have concluded that lateral spreading is restricted to sediments with corrected SPT blow counts of 15 or less for earthquake magnitudes less than or equal to 8.0. The embankment slope along the southwestern side of the site, adjacent to Murrieta Creek, constitutes a free face and possesses a potential for lateral spreading. The observed horizontal ground displacement typically decreases with increased distance from the open face/top of slope. According to Google Earth, the Murrieta Creek embankment is approximately 50 feet from the southern corner of the new apparatus building.

We performed the lateral spreading analysis using the elevation profile function in Google Earth to model the cross section of the Murrieta Creek embankment adjacent to the site. The channel currently has a slope of approximately 14 feet in height with a general inclination of approximately 7:1 (horizontal:vertical). Based on the elevations in the cross section from Google Earth, the alluvial deposits that are potentially susceptible to liquefied alluvium are present at depths of 10 to 46 feet beneath the existing ground surface.

The potential for lateral spreading was evaluated based on the seismic deformation analysis using Newmark's approach in accordance with *Caltrans Guidelines on Foundation Loading Due to Liquefaction Induced Lateral Spreading* (2013) and *FHWA guidelines for LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations* (2011). The geometry of embankment slope, residual strength characteristics of the subsurface soil, site acceleration due to earthquake, as well as the water and groundwater levels are the important parameters in estimating the potential for lateral spreading.

The lateral spreading analysis was performed by modeling the site in SLOPE/W (2007) and using undrained residual strengths within the liquefiable layers based on correlations with the SPT corrected blow count based on studies published by Seed (1987) and Seed & Harder (1990). A fully specified stability analysis was conducted through the liquefied layers to evaluate the acceleration resulting in a factor of safety of 1.0. The permanent displacement was then evaluated by the normalized yield acceleration for embankments after Bray and Travasarou (2007).

Based on a modal magnitude of 6.88, and a PGAm of 0.495g (using a return period 5% in 50 years for PGAm, per Caltrans guidelines, for site class “boundary D/E”) the maximum earthquake-induced horizontal ground displacement is calculated to be on the order of 6.8 inches and occur at the top of the slope and under the southern edge of the proposed apparatus bay building. The calculated earthquake-induced horizontal ground displacement has the potential to cause distress to the planned improvements should liquefaction occur. The structural engineer should evaluate the proposed structures for the anticipated lateral spreading and verify that anticipated deformations would not cause the foundation system to lose the ability to support the gravity loads and/or cause collapse of the structure. Based on the magnitude of the lateral spreading displacements, we anticipate that the effects of lateral spreading can be mitigated in conjunction with structural design and/or ground improvement.

6.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Based on a review of the California Department of Water Resources, *Dam Breach Inundation Map Web Publisher*, the site is not located within a potential inundation area for an earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

6.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

The site is located more than 24 miles from the nearest coastline, with the Santa Ana Mountains lying between the site and the Pacific Ocean; therefore, the risk associated with tsunamis is not a design consideration.

The site is not located downstream from Lake Elsinore, Skinner, Diamond Valley, or other large nearby bodies of water. Therefore, a seiche hazard from these bodies of water are not a design consideration.

The site is within an area of potential flooding per Riverside County, *Map My County* website. Furthermore, in the City of Temecula General Plan, the site is in a 100 Year Flood Zone and Dam Inundation Area.

6.8 Landslides

The site and surrounding lands are relatively flat. Further, no landslides have been geologically mapped on or adjacent to the site. Therefore, landslide hazard to the site is not a design consideration.

6.9 Rockfall

Rockfall hazards are not a design consideration for this project.

6.10 Slope Stability

Slopes are not currently present on the site or anticipated to be constructed during grading. The site is adjacent to the Murrieta Creek embankment and the potential for lateral spread during a seismic event has been evaluated (see Section 6.5 herein). Slope stability analysis of the Murrieta Creek embankment was outside of our scope of services.

6.11 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The City of Temecula General Plan does not indicate that this site is within a potential subsidence area.

7. SITE INFILTRATION

Percolation testing was performed in accordance with the procedures outlined in *Riverside County Flood Control and Water Conservation District LID BMP (2001)*. The percolation test locations are depicted on the *Geologic Map*, Figure 2.

Percolation borings P-1 through P-4 were excavated to depths of 5 and 10 feet. The boreholes were presaturated with 5 gallons of water 24 hours before testing. Percolation data sheets are presented in Appendix A of this report. Results of the converted percolation test to infiltration test rates are presented below.

TABLE 7.0
SUMMARY OF SITE INFILTRATION TEST RESULTS

Parameter	P-1	P-2	P-3	P-4
Depth (inches)	113.5	56.3	52.3	116.0
Test Type	Normal	Normal	Normal	Normal
Change in head over time: ΔH (inches)	3.5	0.7	0.8	3.7
Average head: H_{avg} (inches)	23.9	20.6	20.2	20.7
Time Interval (minutes): Δt (minutes)	30	30	30	30
Radius of test hole: r (inches)	4	4	4	4
Tested Infiltration Rate: I_t (inches/hour)	0.5	0.1	0.2	0.7

The results of the percolation testing indicate that infiltration at the locations tested ranged from 0.1 to 0.7 inches per hour. The Riverside County LID BMP indicates a factor of safety of 3 should be applied to these test results.

The in-situ field percolation tests performed provide short-term infiltration rates, which apply mainly to the initiation of the infiltration process due to the short time of the test (hours instead of days) and the amount of water used. Where appropriate, the short-term infiltration rates shall be converted to long-term infiltration rates using reduction factors depending on the degree of infiltrate quality, maintenance access and frequency, site variability, subsurface stratigraphy variation, and other factors. The small-scale percolation testing cannot model the complexity of the effect of interbedded layers of different soil composition, and our test results should be considered only as index values of infiltration rates.

It is recommended that the proposed infiltration system be located a minimum distance of 20 feet from proposed structures and 15 feet from proposed site improvements to reduce the potential for induced settlements to adversely impact the development. The proposed infiltration system should also be located at least 50 feet from the Murrieta Creek embankment. The civil engineer should evaluate the impact on surface drainage should soil settlement occur locally within the area of the infiltration system. It is suggested that flexible connections be utilized between the storm drainpipes and infiltration chambers.

The infiltration feasibility per the Water Quality Management Plan for the Santa Margarita Region of Riverside County was evaluated for this site. Although Murrieta Creek is located adjacent to the site, infiltration is not expected to negatively impact downstream water rights or other beneficial uses. The site is located in a light industrial area. Seasonal high ground water is expected to be within 10 feet below the ground surface at the property. No water wells are known to be within 100 feet of the proposed infiltration structures. It is assumed that the surrounding businesses are connected to public sewers, therefore, the infiltration structures are not expected to be within a 2:1 (horizontal: vertical) projection of a septic leach line. The soils in which the infiltration structures will be excavated are expected to have adequate physical and chemical properties for infiltration. The project Civil Engineer should review the infiltration rates and determine the storm water treatment structure most appropriate for this project.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

- 8.1.1 We did not encounter soil or geologic conditions during our exploration that would preclude the proposed improvements, provided the recommendations presented herein are followed and implemented during design and construction. Geocon should provide supplemental recommendations if we observe variable or undesirable conditions during construction, or if the proposed construction will differ from that anticipated herein.
- 8.1.2 Our field investigation indicates the site has undocumented artificial fill to depths of up to 10 feet and is underlain by young alluvial valley deposits. The existing artificial fill encountered consists of loose silty sands and soft sandy silts and is underlain by very loose to medium dense and soft to very stiff alluvium to the maximum depth. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs.
- 8.1.3 The enclosed liquefaction analyses indicate that the alluvial soils underlying the site could be prone to approximately 7.2 inches of settlement as a result of the Maximum Earthquake peak ground acceleration (PGA_M). The resulting differential settlement at the ground surface due to liquefaction is anticipated to be up to 3½ inches over a distance of 20 feet. Ground improvement is recommended to reduce the impact of liquefaction on the site and proposed improvements.
- 8.1.4 It should be noted that implementation of the recommendations presented herein is not intended to completely prevent damage to the structures during the occurrence of strong ground shaking as a result of nearby earthquakes. It is intended that the structures be designed in such a way that the amount of damage incurred as a result of strong ground shaking be minimized.
- 8.1.5 Based on the magnitude of anticipated liquefaction settlement and compressibility of the upper soils, it is recommended that soil modification (e.g., stone columns) be considered below the proposed structures. Additionally, consideration should be given to extending the ground improvement below other critical parts of the site to improve site performance and emergency operation functions during and following a seismic event. Recommendations for Stone Columns are provided in Section 8.7.

- 8.1.6 Where supported on improved ground and due to the presence of existing artificial fill, it is recommended that the upper 3 feet of existing soils within the footprint area of the proposed structures be excavated and properly compacted for foundation and slab support. Where feasible, the engineered fill blanket should extend at least 2 feet beyond the edge of foundations or for a distance equal to the depth of fill below the foundations, whichever is greater. Recommendations for earthwork are provided in the Grading section of this report (see Section 8.4).
- 8.1.7 Depending on the season, the soils at the excavation bottom may be moist and may require stabilization measures. Recommendations for stabilization procedures are provided in the *Grading* section of this report (see Section 8.4).
- 8.1.8 Subsequent to the recommended grading and ground improvement, the proposed structure may be supported on either a conventional foundation system or reinforced concrete mat foundation. Recommendations for both types of foundation systems are provided in the Foundations sections of this report (see Sections 8.8 and 8.9).
- 8.1.9 Minor outlying structures can be supported on shallow, conventional foundations without ground improvement provided the owner and structural engineer are willing to accept the magnitude of anticipated static and seismic settlements without ground improvements.
- 8.1.10 In addition to building areas, ground improvements should be considered along the southern property line to help reduce the potential for lateral spread. The enclosed lateral spread analysis indicates that the maximum earthquake-induced horizontal ground displacement is calculated to be up to 6.8 inches at the currently proposed 50-foot building setback. Ground improvement should be designed by a specialty contractor to reduce the potential for lateral spread within and beyond the improvement zones to levels the structural designer deems acceptable.
- 8.1.11 Where new paving is to be placed, it is recommended that existing fill soils and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of existing fill in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable soils may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. Additionally, consideration should be given to extending the ground improvement below other critical parts of the site to improve site performance and emergency operation functions during and following a seismic event. As a minimum, the

upper 12 inches of soil should be scarified and properly compacted for paving support. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report.

- 8.1.12 Once the design and foundation loading configuration for the proposed structure proceeds to a finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations and ground improvements, the potential for settlement should be re-evaluated by this office.
- 8.1.13 Changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

8.2 Soil and Excavation Characteristics

- 8.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Some caving should be anticipated in unshored excavations, especially where granular or saturated soils are encountered.
- 8.2.2 It is the responsibility of the contractor to ensure that excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.
- 8.2.3 Onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report.
- 8.2.4 The soil encountered in the upper 5 feet during the field investigation is considered to be “non-expansive” (expansion index [EI] of 20 or less) as defined by 2022 California Building Code (CBC) Section 1803.5.3. We expect a majority of the soil encountered possess a “very low” to “low” expansion potential (EI of 50 or less) in accordance with ASTM D 4829. Table 8.2.4 presents soil classifications based on the expansion index.

TABLE 8.2.4
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2022 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

8.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

- 8.3.1 Potential of Hydrogen (pH) and resistivity testing, as well as soluble chloride and sulfate testing was performed on a representative soil sample to generally evaluate the corrosion potential to surface utilities. The test results are presented in Appendix B (Figure B-4) and should be considered for the design of underground structures.
- 8.3.2 Laboratory test results indicate a resistivity of 2,600 ohm-cm, pH of 8.3, chloride content of 50 ppm, and sulfate content of 10 ppm. Based on the laboratory test results, the site soils would be considered “non-corrosive” to metals or concrete as defined in Caltrans Corrosion Guidelines (Caltrans, 2021) as shown in Table 8.3.2 below.

TABLE 8.3.2
CALTRANS CORROSION GUIDELINES

Corrosion Exposure	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)	pH
Corrosive	<1,500	500 or greater	1,500 or greater	5.5 or less

- 8.3.3 The laboratory test result of 10 ppm (0.001%) for sulfate content indicates that the on-site soils possess a sulfate exposure class of “S0” to concrete structures as defined by 2022 CBC Section 1904A and ACI 318-19 Chapter 19 as shown in Table 8.3.3. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 8.3.3
REQUIREMENTS FOR CONCRETE EXPOSED TO
SULFATE-CONTAINING SOLUTIONS

Exposure Class		Water-Soluble Sulfate (SO ₄) Percent by Weight	Cement Type (ASTM C150)	Maximum Water to Cement Ratio by Weight ¹	Minimum Compressive Strength (psi)
S0		SO₄<0.10	No Type Restriction	n/a	2,500
S1		0.10≤SO ₄ <0.20	II	0.50	4,000
S2		0.20≤SO ₄ ≤2.00	V	0.45	4,500
S3	Option 1	SO ₄ >2.00	V+Pozzolan or Slag	0.45	4,500
	Option 2		V	0.40	5,000

¹ Maximum water to cement ratio limits do not apply to lightweight concrete.

- 8.3.4 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

8.4 Grading

- 8.4.1 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill and alluvial soil encountered during exploration is suitable for re-use as engineered fill, provided oversized material (greater than 6 inches) and deleterious debris are removed.
- 8.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, ground improvement contractor, and building official in attendance. Special soil handling requirements can be discussed at that time.
- 8.4.3 Grading should commence with the removal of existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. Existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

- 8.4.4 Where supported on improved ground and due to the presence of existing artificial fill, it is recommended that the upper 3 feet of existing soils within the footprint area of the proposed structures be excavated and properly compacted for foundation and slab support. Where feasible, the engineered fill blanket should extend at least 2 feet beyond the edge of foundations or for a distance equal to the depth of fill below the foundations, whichever is greater.
- 8.4.5 The upper alluvial soils encountered during site exploration were very moist and the grading contractor should be aware that the existing soils are currently near or slightly above optimum moisture content. Conditions could change seasonally. If the soils are more than 3 percent above the optimum moisture content at the time of construction the soils will likely require spreading, processing, and drying activities in order to achieve proper compaction.
- 8.4.6 Prior to placing fill, a stable excavation bottom must be established. In areas where the subgrade is saturated or soft, proper compaction will likely not be possible or achieved in a timely manner without introducing stabilization measures. If subgrade stabilization is required at the excavation bottom, rubber tire equipment should not be allowed in the excavation bottom until it is stabilized or extensive soil disturbance could result. It is suggested that excavation and grading be performed during the summer season to promote moisture control of the soils. In addition, the use of track equipment should be used to minimize disturbance to the soils at the excavation bottom.
- 8.4.7 Bottom stabilization, if necessary, may be achieved placing a thin lift of 3- to 6-inch-diameter crushed angular rock into the soft excavation bottom. The use of crushed concrete will also be acceptable. The crushed rock should be spread thinly across the excavation bottom and pressed into the soils by track rolling or wheel rolling with heavy equipment. It is very important that voids between the rock fragments are not created so the rock must be thoroughly pressed or blended into the soils. Subgrade soils must be properly compacted and proof-rolled in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).
- 8.4.8 An additional method of subgrade stabilization would be to place a minimum 12-inch thick layer of aggregate base over Tensar InterAx NX850 geogrid or equivalent extruded (nonwoven) geotextile. The Tensar geogrids should be installed taught and should overlap in accordance with the manufacturer's recommendations. Prior to placing the geogrid,

excessively soft or wet materials should be removed and the resulting excavation bottom should be free of loose material. Non-vibratory compaction methods should be used for compaction of the base material. The aggregate base should be compacted to a dry density of at least 95 percent of the laboratory maximum density near the optimum moisture. If pumping of the subgrade continues, a thicker layer of aggregate base may be placed. It is very important that subgrade stabilization be performed uniformly across the entire excavation bottom.

- 8.4.9 Soil additives, like lime or cement, can also be considered to reduce the moisture content, reduce the expansion potential, and stabilize the upper soils. Recommendations for soil stabilization through the use of lime or cement can be addressed under separate cover, if desired.
- 8.4.10 Fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).
- 8.4.11 It is anticipated that the recommended grading can be achieved with sloping measures. However, excavations in proximity to an adjacent property line and/or structure may require special excavation measures in order to maintain lateral support of existing adjacent improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report.
- 8.4.12 Where new paving is to be placed, it is recommended that existing fill and soft alluvium be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report. The client should be aware that excavation and compaction of existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. Additionally, consideration should be given to extending the ground improvement below other critical parts of the site to improve site performance and emergency operation functions during and following a seismic event.

- 8.4.13 Foundations for small outlying structures, such as non-retaining block walls up to 6 feet in height, planter walls or trash enclosures, which will not be structurally tied-in to existing or proposed structures, may be supported on conventional foundation deriving support on a minimum of 12 inches of newly placed engineered fill that extends at least 12 inches beyond the foundation footprint area. If the soils exposed in the excavation bottom are soft or loose, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and should be performed at the direction of the Geocon representative.
- 8.4.14 It is recommended that flexible utility connections be utilized for rigid utilities to minimize or prevent damage to utilities from minor differential movements. Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry is also acceptable as backfill. Prior to placing bedding material or pipes, the trench excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).
- 8.4.15 Although not anticipated for this project, imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than 20 and corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B-4). Imported soils placed in the building area should be placed uniformly across the building pad or in a manner that is approved by the Geotechnical Engineer (a representative of Geocon).
- 8.4.16 Trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

8.5 Earthwork Grading Factors

- 8.5.1 Estimates of shrinkage factors are based on empirical judgments comparing the material in its existing or natural state as encountered in the exploratory excavations to a compacted state. Variations in natural soil density and in compacted fill density render shrinkage value estimates as rough approximations. As an example, the contractor can compact the fill to a dry density of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has an approximately 10 percent range of control over the fill volume. Due to the variations in the actual shrinkage/bulking factors, a balance area should be provided to accommodate variations.

8.6 Foundation Design – General

- 8.6.1 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.) prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.
- 8.6.2 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.
- 8.6.3 Once the design and foundation loading configurations and ground improvements for the proposed structures proceed to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised by this office.

8.7 Stone Columns

- 8.7.1 It is recommended that soil improvement consisting of stone columns be performed below the proposed structure. This type of ground improvement system has multiple trade names and is designed and installed by a specialty contractor. Subsequent to construction of the stone column system, the proposed structure may be supported on a conventional foundation system deriving support in the improved soils. The foundation system should be designed to derive vertical support from the improved soils and may develop lateral resistance at the foundation perimeter, as well as by friction beneath the foundations, if necessary.

- 8.7.2 The stone columns system is based on soil improvement that consists of installing densified, aggregate columns to depths typically ranging up to about 30 feet below the proposed foundations. The system increases density and lateral stress in the surrounding soil and claims improvement in bearing capacity and settlement potential (potential settlement). Stone columns elements are constructed by creating shafts (commonly 30 inches in diameter) by drilling or displacement methods, and backfilling the open shaft with specially rammed/compacted, open graded crushed rock and Class 2 AB in 10- to 12-inch lifts. It should be noted that creating the shaft using the displacement method, advancing the shaft with a displacement mandrel, reduces the soil cuttings generated during the creation of the shaft. It is anticipated that the displacement method will be suitable for penetrations in the alluvial soils underlying the site.
- 8.7.3 The pattern and depth of ground improvements may vary depending upon the purposes of mitigation and stratigraphic conditions. The ground improvement should be designed to incorporate allowable static settlements in accordance with the recommendations of the project structural engineer. The ground improvement designer is also responsible for evaluating the post-installation static and dynamic settlement within the ground improvement zone and shall provide this information to the project structural engineer to confirm if the planned structure can tolerate the planned settlements after the installation of the ground improvement.
- 8.7.4 Spacing and diameter should be selected by the specialty contractor to obtain level of improvement as outlined herein. The ground improvement should extend laterally outside the edge of planned building structures, where practical. When adjacent basements are present, the stone columns shall be deepened such that a 1:1 projection from the ground improvement passes beneath the adjacent basement footings.
- 8.7.5 The ground improvement design should be based on settlement criteria of a maximum combined static and seismic differential settlement of $\frac{1}{2}$ inch over a distance of 20 feet, or as specified by the project structural engineer.
- 8.7.6 The ground improvement design package should be submitted to Geocon West, Inc. for review at least two weeks prior to mobilization for construction. Within the design package, the specialty contractor should outline a performance and load testing program to verify the effectiveness of the ground improvement and to confirm the bearing capacity of the improved soils with a full-scale load test. During the load testing, a representative of Geocon should be present to observe the ground improvement installation and testing.

The information obtained from the load testing should be used to modify the depth necessary to achieve design capacities, as well as develop installation criteria that can be used during construction.

- 8.7.7 Geocon should be present continuously during installation of the stone column improvements. Geocon's QA/QC observations and documentation will include pier ID, location, depth, diameter, number of lifts, type of aggregate placed, lift thickness, and changed conditions.

8.8 Conventional Foundation Design

- 8.8.1 A conventional foundation system may be used for support of the proposed structures provided foundations derive support on the improved soils. Foundation excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.
- 8.8.2 Continuous footings should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material. Isolated spread foundations should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material. Foundations constructed over ground improvement can achieve relatively high bearing pressures. However, for preliminary design purposes and based on the anticipated structural loads of 2.3 kips per lineal foot, a preliminary bearing pressure of 2,300 psf may be assumed. The final design bearing pressure should be provided by the ground improvement contractor.
- 8.8.3 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.
- 8.8.4 Laboratory consolidation test results indicate the average potential for compression ranges between approximately 2.2% to 5.5% within the upper 10 feet. Based on these test results static settlement on the order of approximately 1.6 inches, with a differential settlement of approximately 0.8 inches across 20 feet is anticipated for the conventional foundations recommended herein. These estimations do not include seismically induced settlement as discussed herein. For conventional foundations, the combined total static plus liquefaction settlement is estimated to be 8.8 inches and differential settlement is estimated to be 4.4 inches across a distance of 20 feet. These estimates do not include consideration of the ground improvement design. These preliminary settlement estimations should be reviewed and revised as necessary after the ground improvement design and foundation loading configurations have been advanced.

- 8.8.5 If depth increases are utilized for the exterior wall footings, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.
- 8.8.6 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.
- 8.8.7 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only and are not intended to be used in lieu of those required for structural purposes.
- 8.8.8 No special subgrade presaturation is required prior to placement of concrete. However, the slab and foundation subgrade should be sprinkled as necessary; to maintain a moist condition as would be expected in concrete placement.
- 8.8.9 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.
- 8.8.10 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

8.9 Mat Foundation Design

- 8.9.1 The proposed structures may alternatively be supported on reinforced concrete mat foundation systems deriving support on the ground improvement. Foundation excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.
- 8.9.2 For preliminary design purposes and based on the anticipated structural loads, a bearing pressure of 2,300 pounds per square foot (psf) may be assumed; however, the final design bearing pressure should be provided by the ground improvement contractor.

- 8.9.3 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.
- 8.9.4 For preliminary design purposes, a modulus of subgrade reaction of 100 pounds per cubic inch (pci) may be utilized for design of the mat foundations where directly underlain by compacted fill and ground improvement. However, the ground improvement contractor should provide the structural engineer a revised modulus value incorporating the planned improvement techniques. This value is a unit value for use with a 1-foot square footing. The modulus should be reduced in accordance with the following equation when used with larger foundations:
- $$K_R = K \left[\frac{B+1}{2B} \right]^2$$
- where: K_R = reduced subgrade modulus
 K = unit subgrade modulus
 B = foundation width (in feet)
- 8.9.5 The thickness of and reinforcement for the mat foundation should be designed by the project structural engineer.
- 8.9.6 Laboratory consolidation test results indicate the average potential for compression ranges between approximately 2.2% to 5.5% within the upper 10 feet. Based on these test results static settlement on the order of approximately 1.6 inches, with a differential settlement of approximately 0.8 inches across 20 feet is anticipated for the conventional foundations recommended herein. These estimations do not include seismically induced settlement as discussed herein. For conventional foundations, the combined total static plus liquefaction settlement is estimated to be 8.8 inches and differential settlement is estimated to be 4.4 inches across a distance of 20 feet. These estimates do not include consideration of the ground improvement design. These preliminary settlement estimations should be reviewed and revised as necessary after the ground improvement design and foundation loading configurations have been advanced.
- 8.9.7 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

- 8.9.8 This office should be provided a copy of the final construction plans so that the recommendations presented herein could be properly reviewed and revised if necessary.

8.10 Miscellaneous Foundations

- 8.10.1 Minor outlying structures can be supported on shallow, conventional foundations without ground improvement provided the owner and structural engineer are willing to accept the magnitude of anticipated static and seismic settlements without ground improvements.
- 8.10.2 Foundations for small outlying structures, such as non-retaining block walls up to 6 feet in height, planter walls or trash enclosures which will not be tied to the proposed structure may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils, and should be deepened as necessary to maintain a minimum 12 inch embedment into the recommended bearing materials.
- 8.10.3 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width, 24 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.
- 8.10.4 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

8.11 Caisson Foundation Design for Light Poles

- 8.11.1 Due to the potential for liquefaction, consideration should be given to extending the ground improvement below proposed light poles to improve performance during and following a seismic event. Without ground improvement, foundations underlain by potentially liquefiable soils may be subject to loss of vertical and lateral capacity and excessive settlements.

- 8.11.2 For preliminary design purposes, we have assumed that friction piles may be used for support of proposed light poles. However, it may be more effective to support the light standards on shallow foundations underlain by ground improvement. Alternate recommendations for light standard foundations can be provided as the project progresses.
- 8.11.3 Friction piles should be a minimum of 18 inches in diameter and should be embedded a minimum of 6 feet into the recommended bearing materials (engineered fill or undisturbed alluvium). Where not protected by pavement, the upper two feet of soil should be ignored when calculating axial and lateral capacity.
- 8.11.4 Friction piles may be designed based on a skin friction capacity of 100 pounds per square foot and do not require the complete removal of all loose earth materials from the bottom of the excavation since the end-bearing capacity is not being considered for design. However, a clean out of the excavation bottom will be required. Single pile uplift capacity can be taken as 60 percent of the allowable downward capacity. The allowable downward capacity and allowable uplift capacity may be increased by one-third when considering transient wind or seismic loads.
- 8.11.5 For design purposes, an allowable passive value for the soils may be assumed to be 260 psf per foot with a maximum earth pressure of 2,600 psf. To develop the full lateral value, provisions should be implemented to assure firm contact between the piles and the engineered fill and underlying alluvium. A one-third increase in the passive value may be used for wind or seismic loads. The allowable capacity may be doubled for isolated piles spaced more than three times the diameter on-center.
- 8.11.6 All drilled pile excavations should be continuously observed by personnel of this firm to verify adequate penetration into the recommended bearing materials. The capacity presented is based on the strength of the soils. The compressive and tensile strength of the pile sections should be checked to verify the structural capacity of the piles.

8.12 Caisson Installation

- 8.12.1 Due to the granular nature of some site soils and the presence of groundwater, caving should be anticipated during drilling of new caissons. The contractor should have casing available prior to commencement of caisson excavations. If casing is used, extreme care should be employed so that the caisson is not pulled apart as the casing is withdrawn. At no time should the distance between the surface of the concrete and the bottom of the casing be less than 5 feet. Continuous observation of the drilling and placement of concrete by a representative of Geocon is required.

- 8.12.2 Friction piles do not require the complete removal of all loose earth materials from the bottom of the excavation since the end-bearing capacity is not being considered for design. However, a clean out of the excavation bottom will be required.
- 8.12.3 Groundwater was encountered during our field exploration at 12.5 feet below ground surface and has been historically as high as 10 feet below ground surface. Caisson excavations with more than 6 inches of standing water level require the use of a tremie to place the concrete into the bottom of the hole.
- 8.12.4 Caisson excavations should be filled with concrete as soon after drilling and inspection as possible; the holes should not be left open overnight unless approved by the Geotechnical Engineer.

8.13 Lateral Design

- 8.13.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.4 may be used with the dead load forces in the newly placed engineered fill.
- 8.13.2 Passive earth pressure for the sides of foundations and slabs poured against newly placed engineered fill may be computed as an equivalent fluid having a density of 260 pounds per cubic foot (pcf) with a maximum earth pressure of 2,600 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. A one-third increase in the passive value may be used for wind or seismic loads.

8.14 Concrete Slabs-on-Grade

- 8.14.1 Exterior concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Preliminary Paving Recommendations* section of this report.
- 8.14.2 Where supported on a conventional foundation system underlain by ground improvement, concrete slabs-on-grade for structures not subject to vehicle loading should be a minimum 4 inches of concrete reinforced with No. 4 steel reinforcing bars placed 16 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint. The slab-on-grade may derive support in the newly placed engineered fill.

- 8.14.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder selection and design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) as well as ASTM E1745 and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the California Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4-inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.
- 8.14.4 For seismic design purposes, a coefficient of friction of 0.4 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.
- 8.14.5 Exterior slabs, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints, as necessary.

- 8.14.6 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

8.15 Preliminary Pavement Recommendations

- 8.15.1 Consideration should be given to extending the ground improvement below other critical parts of the site to improve site performance and emergency operation functions during and following a seismic event.
- 8.15.2 A rigid Portland cement concrete (PCC) pavement section should be placed in roadway aprons and cross gutters. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330 21 Commercial Concrete Parking Lots and Site Paving Design and Construction – Guide. Table 8.15.2 provides the traffic categories and design parameters used for the calculations for 20-year design life.

TABLE 8.15.2
TRAFFIC CATEGORIES

Traffic Category	Description	Reliability (%)	Slabs Cracked at End of Design Life (%)
D	Heavy Duty Trucks (Gross Weight of 80 Kips)	75	15
E	Garbage or Fire Truck Lane	75	15

- 8.15.3 We used the parameters presented in Table 8.15.3 to calculate the pavement design sections. We should be contacted to provide updated design sections, if necessary.

TABLE 8.15.3
RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of Subgrade Reaction, k	50 pci
Modulus of Rupture for Concrete, M_R	500 psi
Concrete Compressive Strength	3,000 psi
Concrete Modulus of Elasticity, E	3,150,000 psi

- 8.15.4 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 8.15.4.

TABLE 8.15.4
RIGID VEHICULAR PAVEMENT RECOMMENDATIONS

Traffic Category	Trucks Per Day	Portland Cement Concrete, T (Inches)
D = Heavy Duty Trucks	50	7½
	100	8½
E = Garbage or Fire Truck Lanes	5	7½
	10	7½

- 8.15.5 The PCC vehicular pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. The garbage truck pad should be large enough such that all wheels are on the concrete pad during the loading operations.

- 8.15.6 Adequate joint spacing should be incorporated into the design and construction of the rigid pavement in accordance with Table 8.15.6.

TABLE 8.15.6
MAXIMUM JOINT SPACING

Pavement Thickness, T (Inches)	Maximum Joint Spacing (Feet)
$4 < T < 5$	10
$5 \leq T < 6$	12.5
$6 \leq T$	15

- 8.15.7 The rigid pavement should also be designed and constructed incorporating the parameters presented in Table 8.15.7.

TABLE 8.15.7
ADDITIONAL RIGID PAVEMENT RECOMMENDATIONS

Subject	Value
Thickened Edge	1.2 Times Slab Thickness Adjacent to Structures
	1.5 Times Slab Thickness Adjacent to Soil
	Minimum Increase of 2 Inches
	4 Feet Wide
Crack Control Joint Depth	Early Entry Sawn = $T/6$ to $T/5$, 1.25 Inch Minimum
	Conventional (Tooled or Conventional Sawing) = $T/4$ to $T/3$
Crack Control Joint Width	$\frac{1}{4}$ -Inch for Sealed Joints and Per Sealer Manufacturer's Recommendations
	$\frac{1}{16}$ - to $\frac{1}{4}$ -Inch is Common for Unsealed Joints

- 8.15.8 Reinforcing steel will not be necessary within the concrete for geotechnical purposes.
- 8.15.9 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should be sealed with an appropriate sealant to prevent the migration of water through the control joint to the subgrade materials. The depth of the crack-control joints should be in accordance with the referenced ACI guide.
- 8.15.10 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab.

- 8.15.11 Concrete curb/gutter should be placed on soil subgrade compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Cross-gutters that receives vehicular should be placed on subgrade soil compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Base materials should not be placed below the curb/gutter, or cross-gutters so water is not able to migrate from the adjacent parkways to the pavement sections. Where flatwork is located directly adjacent to the curb/gutter, the concrete flatwork should be structurally connected to the curbs to help reduce the potential for offsets between the curbs and the flatwork.

8.16 Temporary Excavations

- 8.16.1 Excavations less than 5 feet in height may be required during grading operations. The excavations are expected to expose artificial fill and alluvial soils, which may be subject to caving where granular or saturated soils are exposed. Vertical excavations up to 5 feet in height may be attempted by the contractor where loose soils or caving sands are not present, and where not surcharged by adjacent traffic or structures.
- 8.16.2 Vertical excavations that are surcharged or are greater than 5 feet will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter up to maximum height of 5 feet. A uniform slope does not have a vertical portion.
- 8.16.3 Performing continuous vertical excavations along property lines or adjacent to an existing structure could remove support from the property and/or structure which is not acceptable. Excavations in close proximity to an adjacent property line or structure may require special excavation measures, such as slot-cutting or shoring. If needed, recommendations for slot-cutting and/or shoring can be provided under separate cover.
- 8.16.4 Where temporary slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by our personnel and the contractor's competent person so that modifications of the slopes can be made if variations in the soil conditions occur. Excavations should be stabilized within 30 days of initial excavation.

8.17 Surface Drainage

- 8.17.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.
- 8.17.2 Site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against foundations or retaining walls. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2022 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over descending slopes. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.
- 8.17.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.
- 8.17.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

8.18 Plan Review

- 8.18.1 Grading, foundation, and ground improvement plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations as needed.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

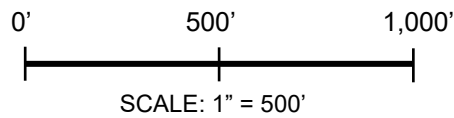
1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.
2. This report is issued with the understanding that it is the responsibility of the owner, or of their representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.
3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.
4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

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SOURCE: Google Earth, 2024



VICINITY MAP

GEOCON
WEST, INC.



GEOTECHNICAL, ENVIRONMENTAL, MATERIALS
41571 CORNING PLACE #101, MURRIETA, CALIFORNIA 92562
PHONE 951-304-2300 www.geoconinc.com

HD

GYM & GARAGE WITH STORAGE
FIRE STATION 73
27415 ENTERPRISE CIRCLE
TEMECULA, CALIFORNIA

FEBRUARY 2024

PROJECT NO. T2652-22-20

FIG. 1



GEOCON LEGEND

Locations are approximate

B-4 GEOTECHNICAL BORING LOCATION



B-2 GEOTECHNICAL BORING LOCATION
(BYERLY, 2014)



P-4 PERCOLATION TEST
LOCATION

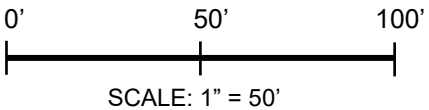


..... SITE BOUNDARY

af PREVIOUSLY PLACED ARTIFICIAL FILL

Qyva YOUNG ALLUVIAL VALLEY DEPOSITS

..... APPROXIMATE GEOLOGIC CONTACT



GEOCON
WEST, INC.



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GEOLOGIC MAP

GYM & GARAGE WITH STORAGE
FIRE STATION 73
27415 ENTERPRISE CIRCLE
TEMECULA, CALIFORNIA

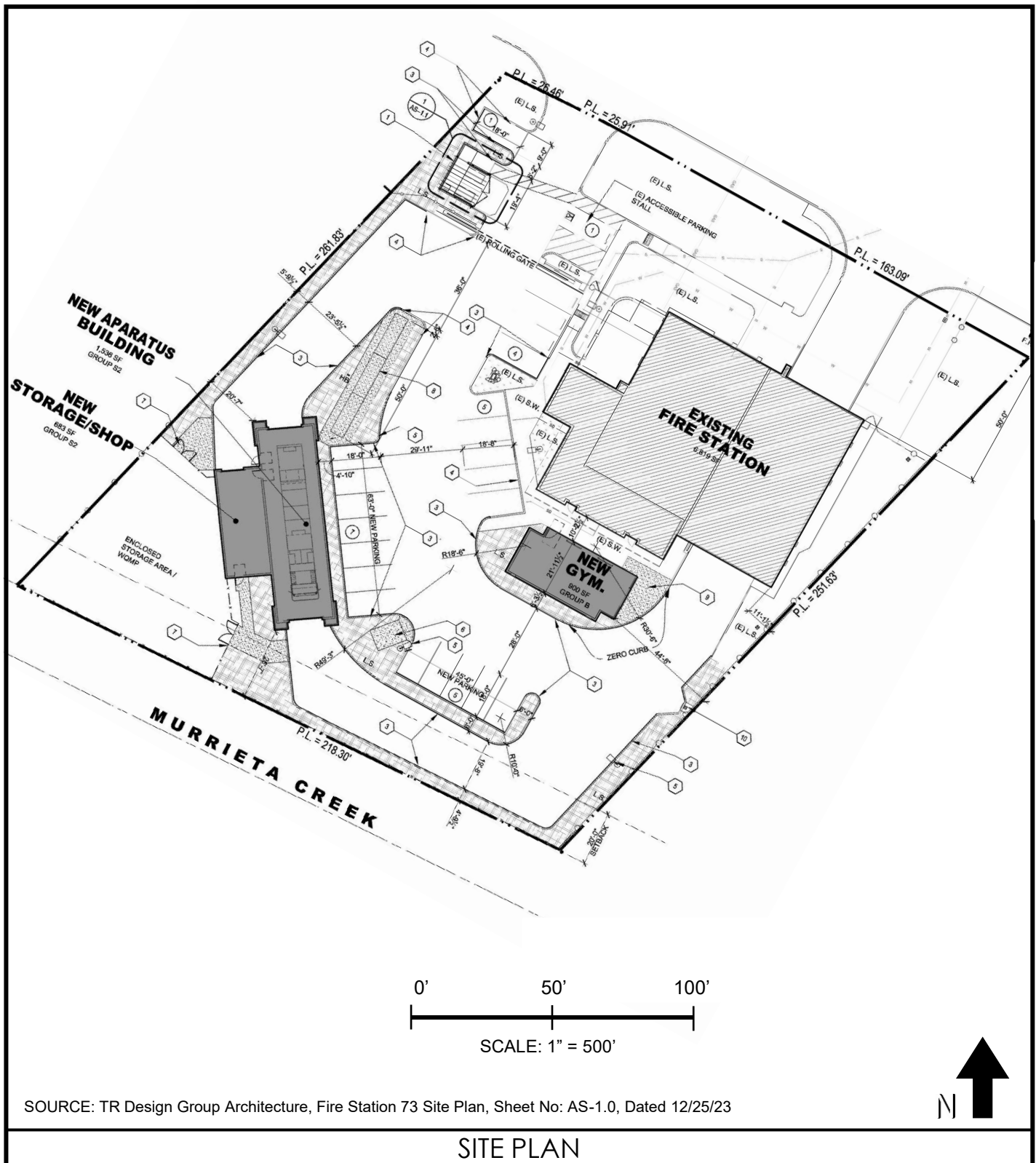
SOURCE: Google Earth, 2023

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FIG. 2



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FEBRUARY 2024	PROJECT NO. T2652-22-20	FIG. 3

APPENDIX

A

APPENDIX A

FIELD INVESTIGATION

The site was explored on January 8, 2024, by excavating eight 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to 51.5 feet beneath the ground surface. Representative and relatively undisturbed samples were obtained by driving a 3-inch, outside diameter (OD), California Modified Sampler or a 2-inch OD Standard Penetration Test (SPT) sampler into the “undisturbed” soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch by 2³/₈-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A-1 through A-8. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The approximate locations of the borings are depicted on the *Geologic Map*, Figure 2.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B-1 ELEV. (MSL.)<u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT<u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B-1@0-5'			SM	ARTIFICIAL FILL (afu) Silty SAND, loose, moist, dark brown; fine to medium grained sand			
2	B-1@2.5'					20	123.3	10.9
4	B-1@5'			ML	Sandy SILT, loose, moist, dark brown (60.8% fines)	22	110.6	17.4
6	B-1@7.5'			SM	YOUNG ALLUVIAL VALLEY DEPOSITS (Qyva) Silty SAND, loose, moist, dark brown; fine to medium grained sand; native, light brown	15	114.2	9.8
10	B-1@10'			CL-ML	Sandy Silty CLAY, medium stiff, moist, dark brown; (84.2% fines)	7	81.3	35.0
12	B-1@12.5'			ML	Sandy SILT, soft, wet, dark brown; fine sand; biotite; (LL=30, PL=23, PI=7, 69.2% fines)	4	73.7	36.7
14	B-1@15'				-Medium stiff	7	101.1	23.8
16	B-1@17.5'				-Stiff	13	100.7	25.5
18	B-1@20'			SC-SM	Silty Clayey SAND, very loose, moist, dark brown; contains biotite; (30.1% fines)	11	104.3	22.4
22	B-1@22.5'			SM	Silty SAND, very loose, moist, dark brown; micaceous; (25.7% fines)	11	102.9	21.9
24	B-1@25'			ML	Sandy SILT, very stiff, moist, dark brown; fine grained; micaceous; some clay; (73.9% fines)	5		
26	B-1@27.5'				-Trace clay; (69.7% fines)	26	104.0	29.0
28								

Figure A-1,
Log of Boring B-1, Page 1 of 2

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B-2 ELEV. (MSL.)<u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT<u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30					MATERIAL DESCRIPTION			
	B-2@30'			SP	Poorly-graded SAND, loose, wet, yellow brown; medium to coarse grained	13		
					Total depth 31' 6" Groundwater encountered at 12' 3" Penetration resistance for 140 lb. hammer falling 30" by auto-hammer Backfilled with cuttings on 1/8/2024			

Figure A-2,
Log of Boring B-2, Page 2 of 2

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B-3 ELEV. (MSL.)<u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT<u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30					MATERIAL DESCRIPTION			
	B-3@30'			SP	Poorly-graded SAND, medium dense, wet, gray; medium to coarse grained	23		
					Total depth 31' 6" Groundwater encountered at 20' 5" Penetration resistance for 140 lb. hammer falling 30" by auto-hammer Backfilled with cuttings on 1/8/2024			

Figure A-3,
Log of Boring B-3, Page 2 of 2

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B-4		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>1027</u> DATE COMPLETED <u>1/8/2024</u>				
					EQUIPMENT <u>HOLLOW STEM AUGER</u>				

**Figure A-4,
Log of Boring B-4, Page 1 of 2**

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B-4 ELEV. (MSL.)<u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT<u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30					MATERIAL DESCRIPTION			
	B-4@30'			SP	Poorly-graded SAND, medium dense, wet, gray brown; medium to coarse grained sand; trace gravel	23		
					Total depth 31' 6" Groundwater encountered at 12' 3" Penetration resistance for 140 lb. hammer falling 30" by auto-hammer Backfilled with cuttings on 1/8/2024			

Figure A-4,
Log of Boring B-4, Page 2 of 2

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL

☒ ... DISTURBED OR BAG SAMPLE

☐ ... STANDARD PENETRATION TEST

☒ ... CHUNK SAMPLE

☐ ... DRIVE SAMPLE (UNDISTURBED)

☒ ... WATER TABLE OR SEEPAGE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING P-1 ELEV. (MSL.) <u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	P-1@0-5'			SM	ARTIFICIAL FILL (afu) Silty SAND, moist, red brown; fine to medium grained sand; trace clay			
2				SM	YOUNG ALLUVIAL VALLEY DEPOSITS (Qyva) -Becomes gray brown			
4								
6								
8								
10	P-1@8.5'				-Medium dense, brown; interlayers of clean poorly-graded sand, gray brown; micaceous; (87% Sand, 13% fines); Perc: 8.6 min/in	17		
					Total Depth = 10' No Groundwater encountered Set 10' perforated pipe with filter sock and gravel			

Figure A-5,
Log of Boring P-1, Page 1 of 1

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING P-2 ELEV. (MSL.)<u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT<u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	P-2@0-5'	BULK DISPT		SM	MATERIAL DESCRIPTION			
2				SM	ARTIFICIAL FILL (afu) Silty SAND, moist, red brown			
4	P-2@3.5'				YOUNG ALLUVIAL VALLEY DEPOSITS (Qyva) -Trace of clay; fine to medium grained sand; trace gravel fill; (68% Sand, 31% fines); Perc: 41.7 min/in	8		
					Total Depth = 5' No Groundwater encountered Set 5' perforated pipe with filter sock and gravel			

Figure A-6,
Log of Boring P-2, Page 1 of 1

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING P-3 ELEV. (MSL.) <u>1027</u> DATE COMPLETED <u>1/8/2024</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>A.LOVE</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	P-3@0-5'			SM	MATERIAL DESCRIPTION ARTIFICIAL FILL (afu) Silty SAND, moist, brown; fine to medium grained sand			
2				SM	YOUNG ALLUVIAL VALLEY DEPOSITS (Qyva) Interlayers of poorly-graded SAND (58% Sand, 41% fines); Perc: 35.7 min/in			
4	P-3@3.5'					8		
Total Depth = 5' No Groundwater encountered Set 5' perforated pipe with filter sock and gravel								

Figure A-7,
Log of Boring P-3, Page 1 of 1

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

T2652-22-20 BORING LOGS.GPJ

SAMPLE SYMBOLS

 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

GEOCON

PERCOLATION TEST REPORT							
Project Name:		Temecula FS 73		Project No.:		T2652-22-20	
Test Hole No.:		P-1		Date Excavated:		1/8/2024	
Length of Test Pipe:		120.0 inches		Soil Classification:		SM w/ SP	
Height of Pipe above Ground:		6.5 inches		Presoak Date:		1/8/2024	
Depth of Test Hole:		113.5 inches		Perc Test Date:		1/9/2024	
Check for Sandy Soil Criteria Tested by:		ADL		Percolation Tested by:		ADL	
Water level measured from BOTTOM of hole							
Sandy Soil Criteria Test							
Trial No.	Time	Time Interval	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	10:18 AM	25	25	25.3	16.9	8.4	3.0
	10:43 AM						
2	10:46 AM	25	50	23.4	16.3	7.1	3.5
	11:11 AM						
Soil Criteria: Normal							
Percolation Test							
Reading No.	Time	Time Interval	Total Elapsed Time (min)	Initial Water Head (in)	Final Water Head (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	11:15 AM	30	30	21.6	15.6	6.0	5.0
	11:45 AM						
2	11:45 AM	30	60	24.1	18.5	5.6	5.3
	12:15 PM						
3	12:16 PM	30	90	25.0	19.7	5.3	5.7
	12:46 PM						
4	12:49 PM	30	120	20.2	15.2	4.9	6.1
	1:19 PM						
5	1:20 PM	30	150	25.8	21.1	4.7	6.4
	1:50 PM						
6	1:55 PM	30	180	26.6	22.0	4.7	6.4
	2:25 PM						
7	2:27 PM	30	210	24.5	19.8	4.7	6.4
	2:57 PM						
8	3:01 PM	30	240	23.2	19.1	4.1	7.4
	3:31 PM						
9	3:34 PM	30	270	22.6	18.5	4.1	7.4
	4:04 PM						
10	4:07 PM	30	300	23.9	20.4	3.5	8.6
	4:37 PM						
11	4:40 PM	30	330	24.6	21.1	3.5	8.6
	5:10 PM						
12	5:13 PM	30	360	25.7	22.2	3.5	8.6
	5:43 PM						
Infiltration Rate (in/hr):		0.5					
Radius of test hole (in):		4				Figure A-9	
Average Head (in):		23.9					

PERCOLATION TEST REPORT

Project Name:		Temecula FS 73			Project No.:		T2652-22-20
Test Hole No.:		P-2			Date Excavated:	1/8/2024	
Length of Test Pipe:			60.0	inches	Soil Classification:	SM	
Height of Pipe above Ground:			3.7	inches	Presoak Date:	1/8/2024	
Depth of Test Hole:			56.3	inches	Perc Test Date:	1/9/2024	
Check for Sandy Soil Criteria Tested by:				ADL	Percolation Tested by:	ADL	
Water level measured from BOTTOM of hole							
Sandy Soil Criteria Test							
Trial No.	Time	Time	Total	Initial Water	Final Water	Δ in Water	Percolation
		Interval	Elapsed	Level	Level	Level	Rate
		(min)	Time (min)	(in)	(in)	(in)	(min/inch)
1	10:26 AM	25	25	21.5	20.3	1.2	20.8
	10:51 AM						
2	10:51 AM	25	50	21.8	20.9	1.0	26.0
	11:16 AM						
		Soil Criteria: Normal					
		Percolation Test					
Reading No.	Time	Time	Total	Initial Water	Final Water	Δ in Water	Percolation
		Interval	Elapsed	Head	Head	Level	Rate
		(min)	Time (min)	(in)	(in)	(in)	(min/inch)
1	11:19 AM	30	30	24.5	23.4	1.1	27.8
	11:49 AM						
2	11:50 AM	30	60	23.3	22.2	1.1	27.8
	12:20 PM						
3	12:21 PM	30	90	20.8	19.8	1.0	31.3
	12:51 PM						
4	12:52 PM	30	120	21.6	20.6	1.0	31.3
	1:22 PM						
5	1:23 PM	30	150	21.7	20.8	1.0	31.3
	1:53 PM						
6	1:56 PM	30	180	21.2	20.3	1.0	31.3
	2:26 PM						
7	2:29 PM	30	210	23.4	22.4	1.0	31.3
	2:59 PM						
8	3:02 PM	30	240	22.0	21.1	0.8	35.7
	3:32 PM						
9	3:33 PM	30	270	21.0	20.3	0.7	41.7
	4:03 PM						
10	4:09 PM	30	300	22.2	21.5	0.7	41.7
	4:39 PM						
11	4:42 PM	30	330	23.4	22.7	0.7	41.7
	5:12 PM						
12	5:15 PM	30	360	21.0	20.3	0.7	41.7
	5:45 PM						
Infiltration Rate (in/hr):			0.1				
Radius of test hole (in):			4				Figure A-10
Average Head (in):			20.6				

PERCOLATION TEST REPORT

Project Name:		Temecula FS 73			Project No.:		T2652-22-20
Test Hole No.:		P-3			Date Excavated:	1/8/2024	
Length of Test Pipe:			60.0	inches	Soil Classification:	SM	
Height of Pipe above Ground:			7.8	inches	Presoak Date:	1/8/2024	
Depth of Test Hole:			52.3	inches	Perc Test Date:	1/9/2024	
Check for Sandy Soil Criteria Tested by:				ADL	Percolation Tested by:	ADL	
Water level measured from BOTTOM of hole							
Sandy Soil Criteria Test							
Trial No.	Time	Time	Total	Initial Water	Final Water	Δ in Water	Percolation
		Interval	Elapsed	Level	Level	Level	Rate
		(min)	Time (min)	(in)	(in)	(in)	(min/inch)
1	10:04 AM	25	25	27.4	25.0	2.4	10.4
	10:34 AM						
2	10:34 AM	25	50	25.7	23.5	2.3	11.0
	10:59 AM						
		Soil Criteria: Normal					
		Percolation Test					
Reading	Time	Time	Total	Initial Water	Final Water	Δ in Water	Percolation
No.		Interval	Elapsed	Head	Head	Level	Rate
		(min)	Time (min)	(in)	(in)	(in)	(min/inch)
1	11:06 AM	30	30	23.0	20.6	2.4	12.5
	11:36 AM						
2	11:40 AM	30	60	23.9	21.8	2.2	13.9
	12:10 PM						
3	12:13 PM	30	90	20.5	18.3	2.2	13.9
	12:43 PM						
4	12:44 PM	30	120	25.3	23.3	1.9	15.6
	1:14 PM						
5	1:17 PM	30	150	23.3	21.4	1.9	15.6
	1:47 PM						
6	1:51 PM	30	180	21.8	20.0	1.8	16.7
	2:21 PM						
7	2:23 PM	30	210	21.1	19.9	1.2	25.0
	2:54 PM						
8	2:57 PM	30	240	20.0	18.9	1.1	27.8
	3:27 PM						
9	3:30 PM	30	270	20.6	19.6	1.0	31.3
	4:00 PM						
10	4:02 PM	30	300	20.6	19.7	0.8	35.7
	4:32 PM						
11	4:33 PM	30	330	20.3	19.5	0.8	35.7
	5:03 PM						
12	5:05 PM	30	360	20.6	19.7	0.8	35.7
	5:35 PM						
Infiltration Rate (in/hr):			0.2				
Radius of test hole (in):			4				Figure A-11
Average Head (in):			20.2				

PERCOLATION TEST REPORT							
Project Name:		Temecula FS 73		Project No.:		T2652-22-20	
Test Hole No.:		P-4		Date Excavated:		1/8/2024	
Length of Test Pipe:		120.0 inches		Soil Classification:		SM w/ SP	
Height of Pipe above Ground:		4.0 inches		Presoak Date:		1/8/2024	
Depth of Test Hole:		116.0 inches		Perc Test Date:		1/9/2024	
Check for Sandy Soil Criteria Tested by:		ADL		Percolation Tested by:		ADL	
Water level measured from BOTTOM of hole							
Sandy Soil Criteria Test							
Trial No.	Time	Time Interval	Total Elapsed Time (min)	Initial Water Level (in)	Final Water Level (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	12:00 AM	25	25	28.4	14.5	13.9	1.8
	10:26 AM						
2	10:29 AM	25	50	26.5	20.8	5.6	4.4
	10:54 AM						
Soil Criteria: Normal							
Percolation Test							
Reading No.	Time	Time Interval	Total Elapsed Time (min)	Initial Water Head (in)	Final Water Head (in)	Δ in Water Level (in)	Percolation Rate (min/inch)
1	11:05 AM	30	30	20.0	13.4	6.6	4.5
	11:35 AM						
2	11:39 AM	30	60	27.0	20.7	6.2	4.8
	12:09 PM						
3	12:12 PM	30	90	21.7	16.0	5.6	5.3
	12:42 PM						
4	12:45 PM	30	120	24.4	19.4	5.0	6.0
	1:15 PM						
5	1:16 PM	30	150	24.2	19.5	4.7	6.4
	1:46 PM						
6	1:47 PM	30	180	24.4	19.9	4.6	6.6
	2:17 PM						
7	2:22 PM	30	210	24.6	20.0	4.6	6.6
	2:52 PM						
8	2:56 PM	30	240	23.2	19.3	4.0	7.6
	3:26 PM						
9	3:29 PM	30	270	24.4	20.6	3.8	7.8
	3:59 PM						
10	4:01 PM	30	300	23.2	19.5	3.7	8.1
	4:31 PM						
11	4:34 PM	30	330	22.5	18.8	3.7	8.1
	5:04 PM						
12	5:10 PM	30	360	22.5	18.8	3.7	8.1
	5:40 PM						
Infiltration Rate (in/hr):		0.7					
Radius of test hole (in):		4				Figure A-12	
Average Head (in):		20.7					

Boring 1

Boring Date: 3/17/14

Surface Elevation:

Drilling Method: Flight-auger

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog\PROJECTS\13519 (Rpt. No. 2418).log Date: 9/10/2014

Depth	Std. Pen. "N" Value	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	Brown silty fine to coarse sand, moist and loose (FILL)
	2.8	101	10.6	75			SM	Dark gray-brown silty fine to coarse sand, very moist and loose (FILL)
	3.5	109	15.9	81			SM	Gray silty fine to medium sand with clay, very moist and loose (FILL)
5	5.3	105	19.0	86			SP	Dark gray fine sand with some clay seams, very moist and medium dense (FILL)
12								
10	2.5	92	28.5	77			SM	Dark gray silty fine sand with clay, very moist and loose (ORIGINAL GROUND) - with seams of sandy silt at 11.0 feet
15	3.9	99	34.3	79			ML	Gray-brown sandy silt with clay, very moist and very soft - becoming saturated at 16.0 feet
20	6.3	104	21.2	87			SM	Dark gray-brown silty fine sand, saturated and medium dense
							SC	Gray-brown clayey fine sand, saturated and loose
25	3.9	99	23.8	83			SM	Dark gray silty fine sand with clay, very moist and loose
30	17.3	123	15.1	92			SM	Gray silty fine to coarse sand, very moist and dense
33								
35								

LOG OF BORING



John R. Byerly, Inc.

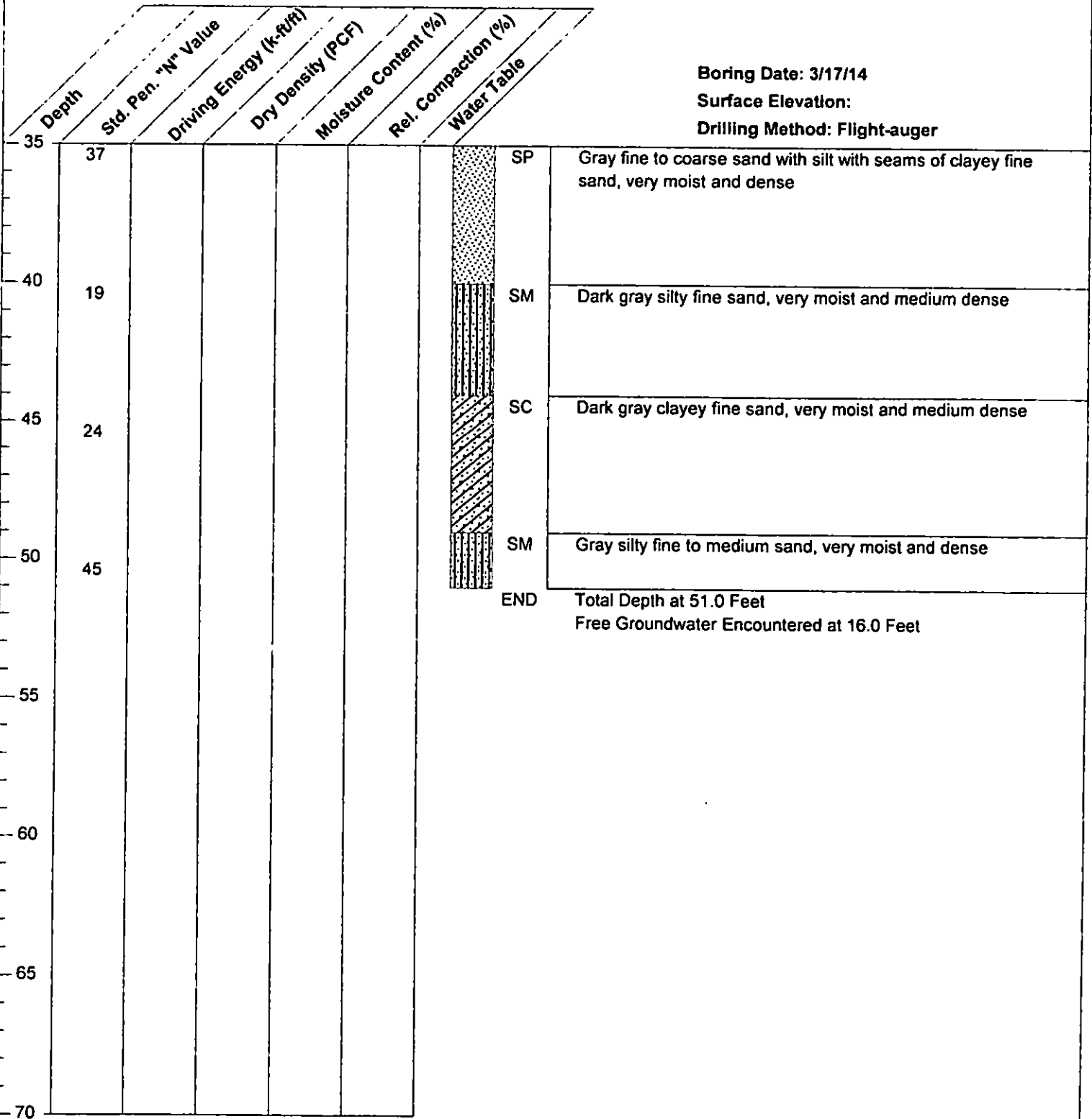
**Temecula Fire Station No. 73
Building Addition/Outdoor Storage**

Enclosure 2, Page 1
Rpt. No.: 2418
File No.: S-13519

FIGURE A-13

Boring 1

Boring Date: 3/17/14
Surface Elevation:
Drilling Method: Flight-auger



LOG OF BORING



John R. Byerly, Inc.

**Temecula Fire Station No. 73
Building Addition/Outdoor Storage**

Enclosure 2, Page 2
Rpt. No.: 2418
File No.: S-13519

FIGURE A-13

Boring 2

Boring Date: 3/17/14

Surface Elevation:

Drilling Method: Flight-auger

SuperLog ChivTech Software, USA www.chivtech.com File: C:\Superlog\PROJECTS-13519 (Rpt. No. 2418).log Date: 9/10/2014

Depth	Std. Pen. "N" Value	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	4.0 inches of portland cement concrete pavement
	12.0	119	6.0	89				Brown silty fine to coarse sand, damp and medium dense (FILL)
	7.0	117	7.6	87			SM	Gray silty fine to coarse sand, moist and medium dense (FILL)
5	15.1	125	9.2	93				- becoming dense at 5.0 feet
	6.0	104	8.9	85			SP	Gray fine sand, moist and medium dense (FILL)
10	2.8	93	27.9	78			SM	Gray-brown silty fine sand with clay, very moist and loose (ORIGINAL GROUND)
15	2.1	93	32.5	74			ML	Gray-brown sandy silt with clay, very moist and soft - becoming saturated at 15.0 feet
20	5.3	103	21.6	86			SM	Dark gray-brown silty fine sand, very moist and medium dense
25	4.6	102	27.9	85			SM	Dark gray-brown silty fine sand with some clay, very moist and medium dense
30	6.7	118	19.4	88			SM	Dark gray silty fine to coarse sand, very moist and medium dense
35							END	Total Depth at 31.0 Feet Free Groundwater Encountered at 15.0 Feet

LOG OF BORING



John R. Byerly, Inc.

**Temecula Fire Station No. 73
Building Addition/Outdoor Storage**

Enclosure 2, Page 3
Rpt. No.: 2418
File No.: S-13519

FIGURE A-14

APPENDIX

B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with current, generally accepted test methods of ASTM International (ASTM) or other suggested procedures. Laboratory tests were performed on select soil samples obtained during our initial field investigation to evaluate pertinent physical soil properties for the proposed development. The laboratory testing program consisted of maximum dry density and optimum moisture content, expansion index, corrosion screening, grain size distribution, consolidation, direct shears, and Atterberg limits. The in-place moisture content of the samples tested are presented on the boring logs in Appendix A.

Sample No:

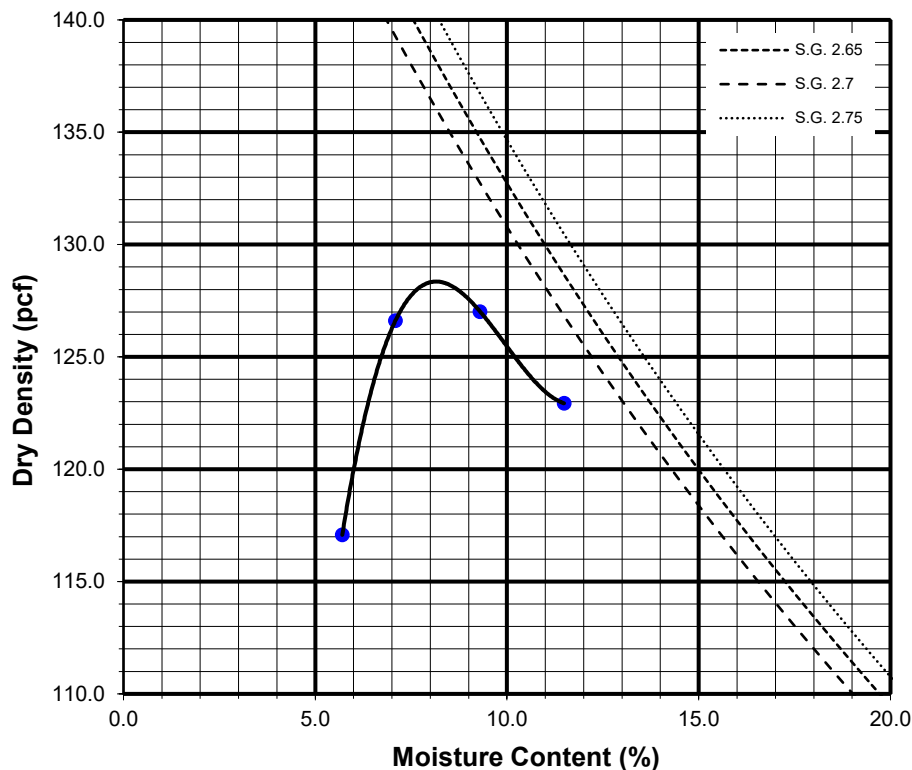
B-1@0-5

Silty SAND (SM), brown

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6307	6355	6329	6128		
Weight of Mold	(g)	4258	4258	4258	4258	4258	
Net Weight of Soil	(g)	2048	2097	2070	1869	-4258	
Wet Weight of Soil + Cont.	(g)	684.1	625.1	623.0	773.1		
Dry Weight of Soil + Cont.	(g)	655.9	593.8	585.3	745.2		
Weight of Container	(g)	258.3	257.2	257.1	256.1		
Moisture Content	(%)	7.1	9.3	11.5	5.7		
Wet Density	(pcf)	135.6	138.8	137.1	123.8	-281.9	
Dry Density	(pcf)	126.6	127.0	122.9	117.1		

Maximum Dry Density (pcf) 128.0

Optimum Moisture Content (%) 8.0



Preparation Method: A



**COMPACTION CHARACTERISTICS USING
MODIFIED EFFORT TEST RESULTS**

ASTM D-1557

Checked by: ADL

Project No.: T2652-22-20

Fire Station 73 New Gym & Garage with Storage
27415 Enterprise Circle, Temecula California

February 2024

Figure B-1

Sample No:

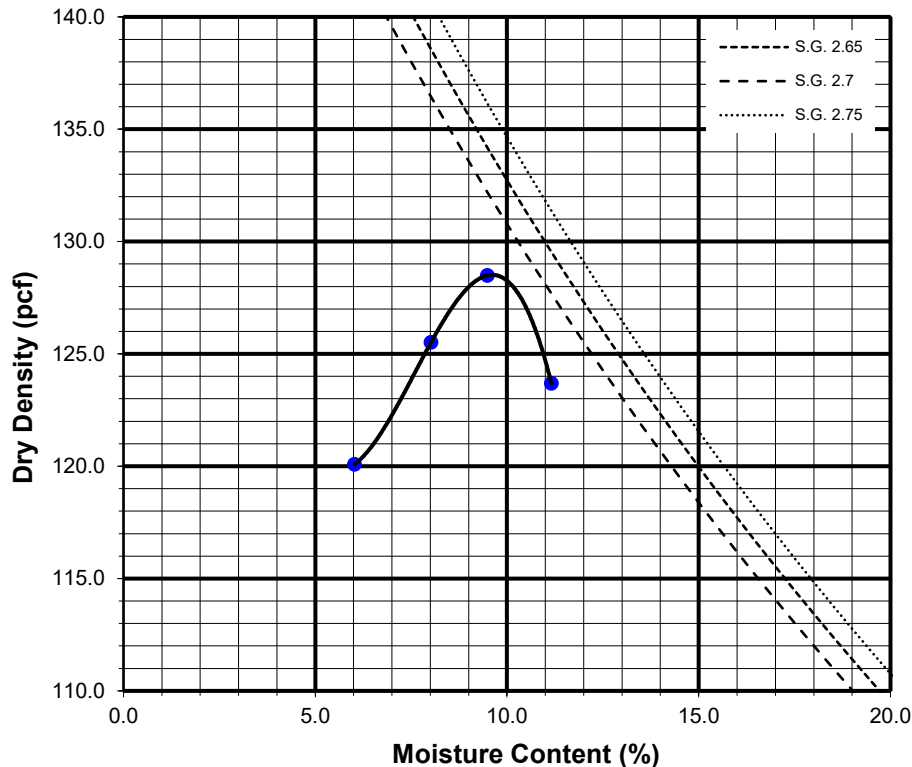
B-4@0-5

Silty SAND (SM), dark grayish brown

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6383	6335	6306	6181		
Weight of Mold	(g)	4258	4258	4258	4258	4258	
Net Weight of Soil	(g)	2125	2077	2048	1923	-4258	
Wet Weight of Soil + Cont.	(g)	716.4	683.8	685.5	789.2		
Dry Weight of Soil + Cont.	(g)	676.6	640.9	653.5	759.1		
Weight of Container	(g)	257.0	256.4	254.4	259.4		
Moisture Content	(%)	9.5	11.2	8.0	6.0		
Wet Density	(pcf)	140.7	137.5	135.6	127.3	-281.9	
Dry Density	(pcf)	128.5	123.7	125.5	120.1		

Maximum Dry Density (pcf) 128.5

Optimum Moisture Content (%) 9.5



Preparation Method: A



**COMPACTION CHARACTERISTICS USING
MODIFIED EFFORT TEST RESULTS**

ASTM D-1557

Checked by: ADL

Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-2

B-2@0-5

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	621.1	641.2
Wt. of Mold	(gm)	200.4	200.4
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	473.3	641.2
Dry Wt. of Soil + Cont.	(gm)	450.1	388.1
Wt. of Container	(gm)	173.3	200.4
Moisture Content	(%)	8.4	13.6
Wet Density	(pcf)	126.9	132.8
Dry Density	(pcf)	117.1	116.9
Void Ratio		0.4	0.4
Total Porosity		0.3	0.3
Pore Volume	(cc)	63.3	64.4
Degree of Saturation	(%) [S_{meas}]	51.9	81.8

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
1/12/2024	10:00	1.0	0	0.3068
1/12/2024	10:10	1.0	10	0.3067
Add Distilled Water to the Specimen				
1/13/2024	10:00	1.0	1430	0.3124
1/13/2024	11:00	1.0	1490	0.3124

Expansion Index (EI meas) =	5.7
Expansion Index (Report) =	6

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.



EXPANSION INDEX TEST RESULTS

ASTM D-4829

Checked by: ADL

Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-3

SUMMARY OF LABORATORY
POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
AASHTO T289 ASTM D4972 and AASHTO T288 ASTM G187

Sample No.	pH	Resistivity (ohm centimeters)
B-3@0-5	8.3	2600

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
AASHTO T291 ASTM C1218

Sample No.	Chloride Ion Content (%)
B-3@0-5	0.005

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO ₄)	Sulfate Exposure
B-3@0-5	0.001	S0



CORROSIVITY TEST RESULTS

Checked by: ADL

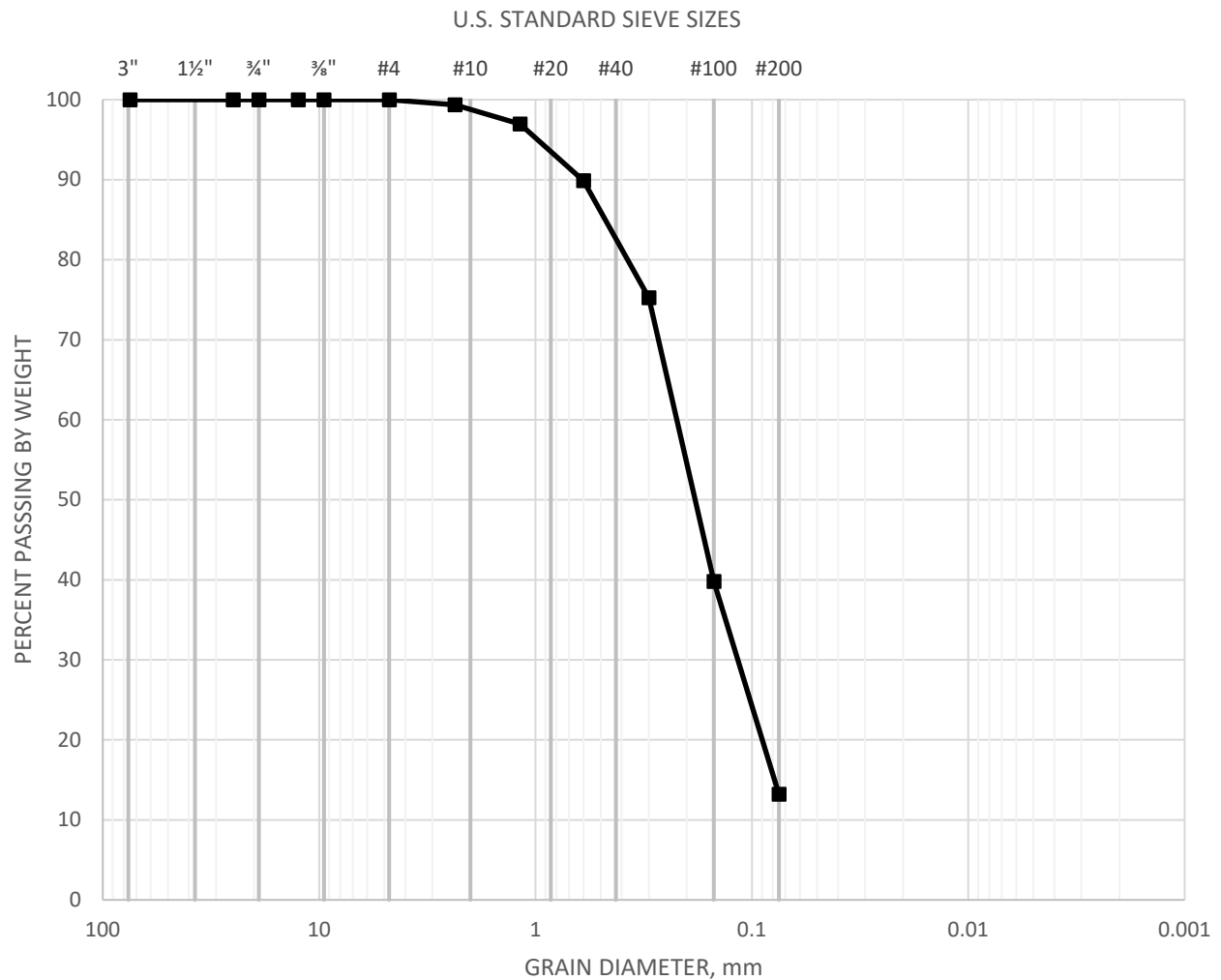
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-4

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	GRAVEL	SAND	FINES
P-1@8.5-10	Silty SAND (SM), dark gray	0%	87%	13%



GRAIN SIZE DISTRIBUTION

ASTM D 6913

Checked by: ADL

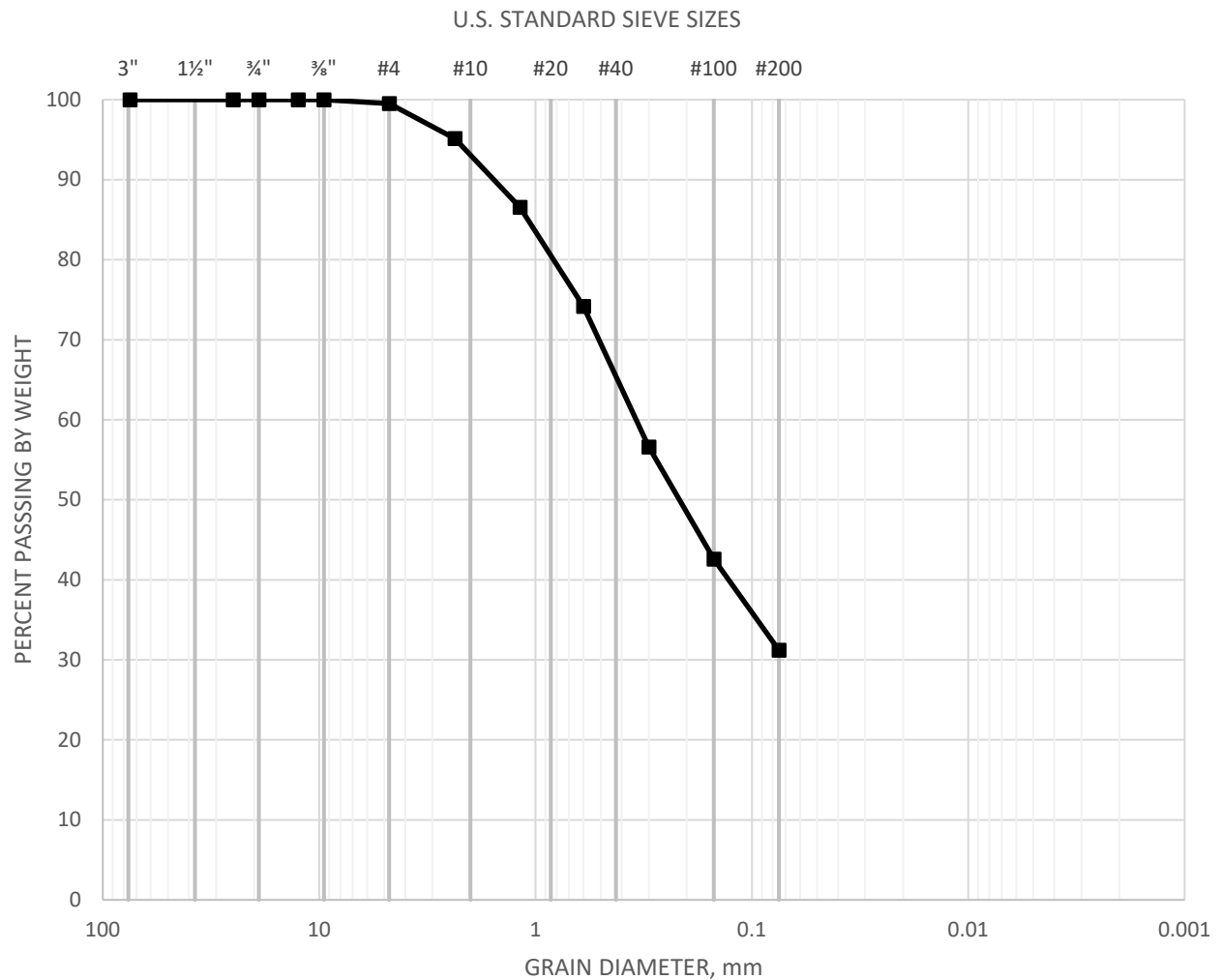
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-5

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	GRAVEL	SAND	FINES
P-2@3.5-5	Silty SAND (SM), dark brown	0%	68%	31%



GRAIN SIZE DISTRIBUTION

ASTM D 6913

Checked by: ADL

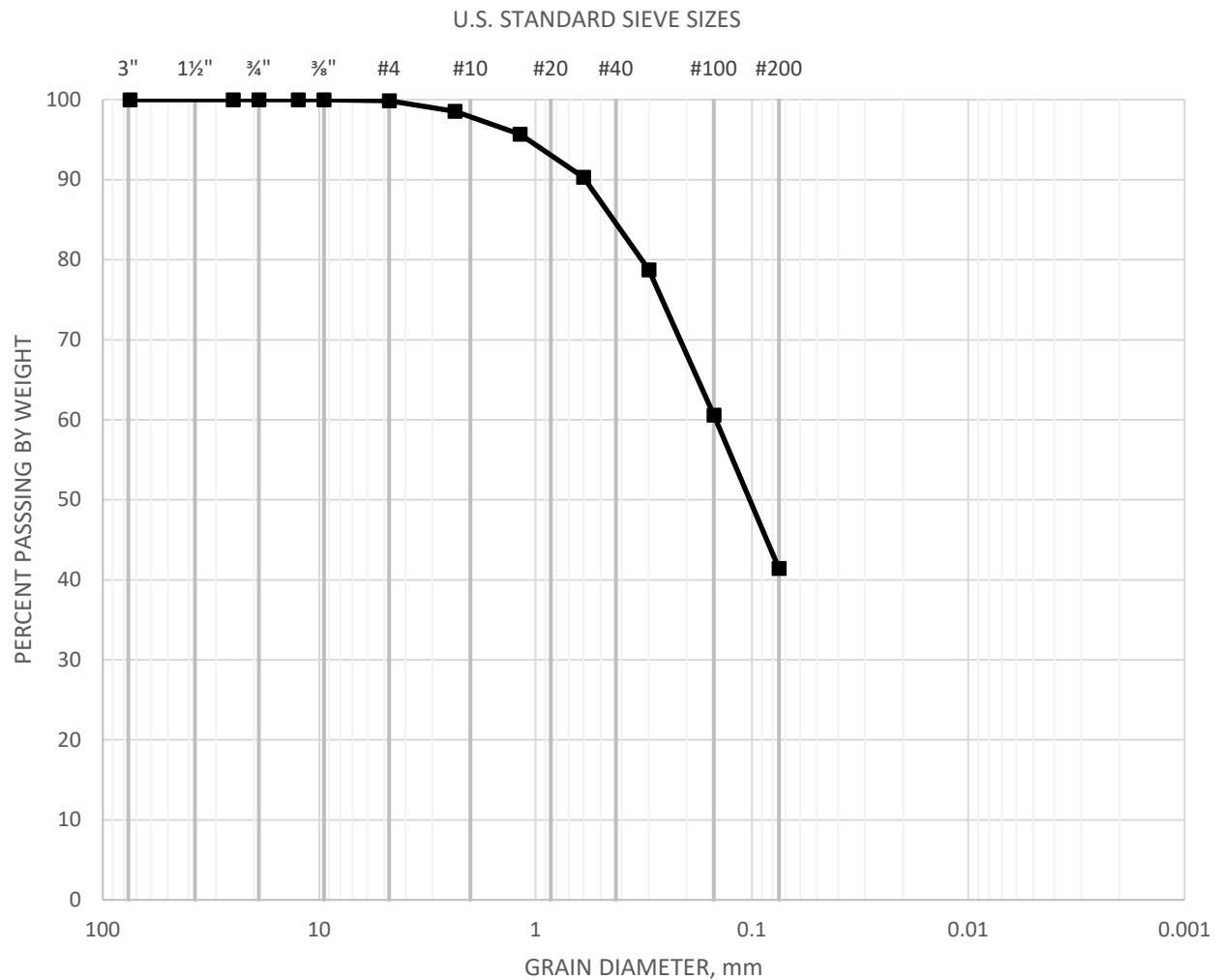
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-6

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	GRAVEL	SAND	FINES
P-3@3.5-5	Silty SAND (SM), dark brown	0%	58%	41%



GRAIN SIZE DISTRIBUTION

ASTM D 6913

Checked by: ADL

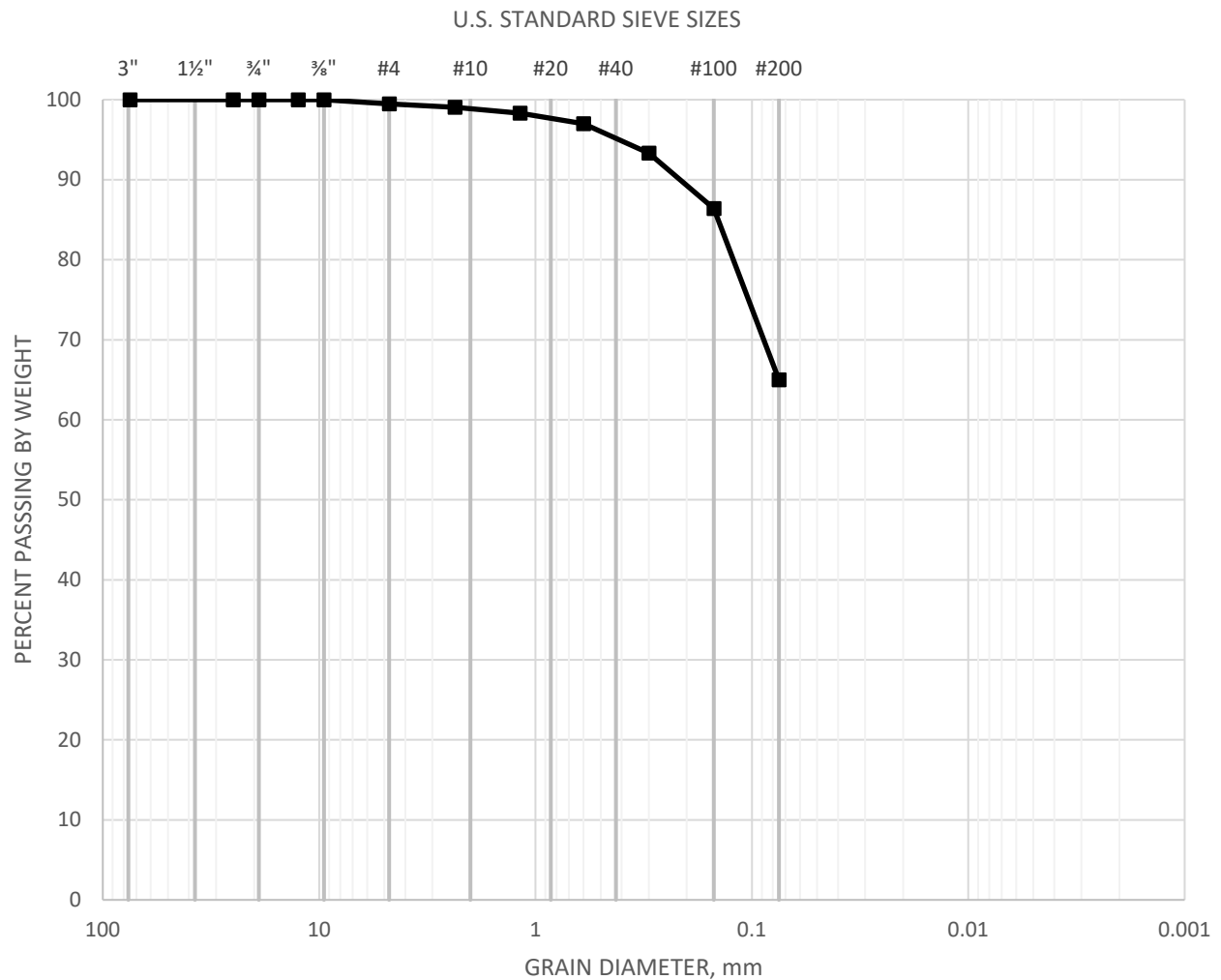
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-7

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	GRAVEL	SAND	FINES
P-4@8.5-10	SILT with Sand (ML)s, dark brown	1%	34%	65%



GRAIN SIZE DISTRIBUTION

ASTM D 6913

Checked by: ADL

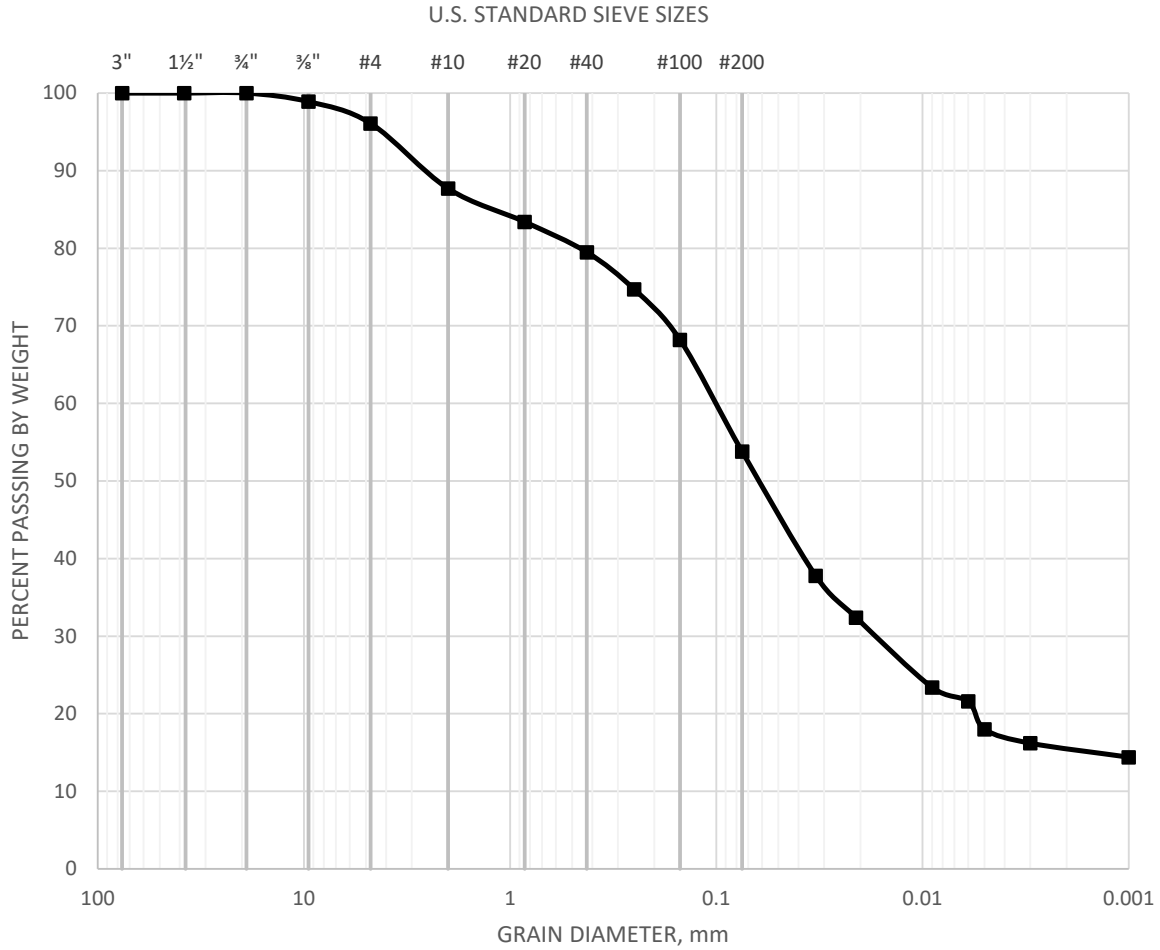
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-8

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	Sand	Silt	Clay
		%		
B-2@5	Sandy SILT (ML), dark brown	42.3	35.8	18



GEOCON

GRAIN SIZE DISTRIBUTION WITH HYDROMETER

ASTM D-422

Checked by: ADL

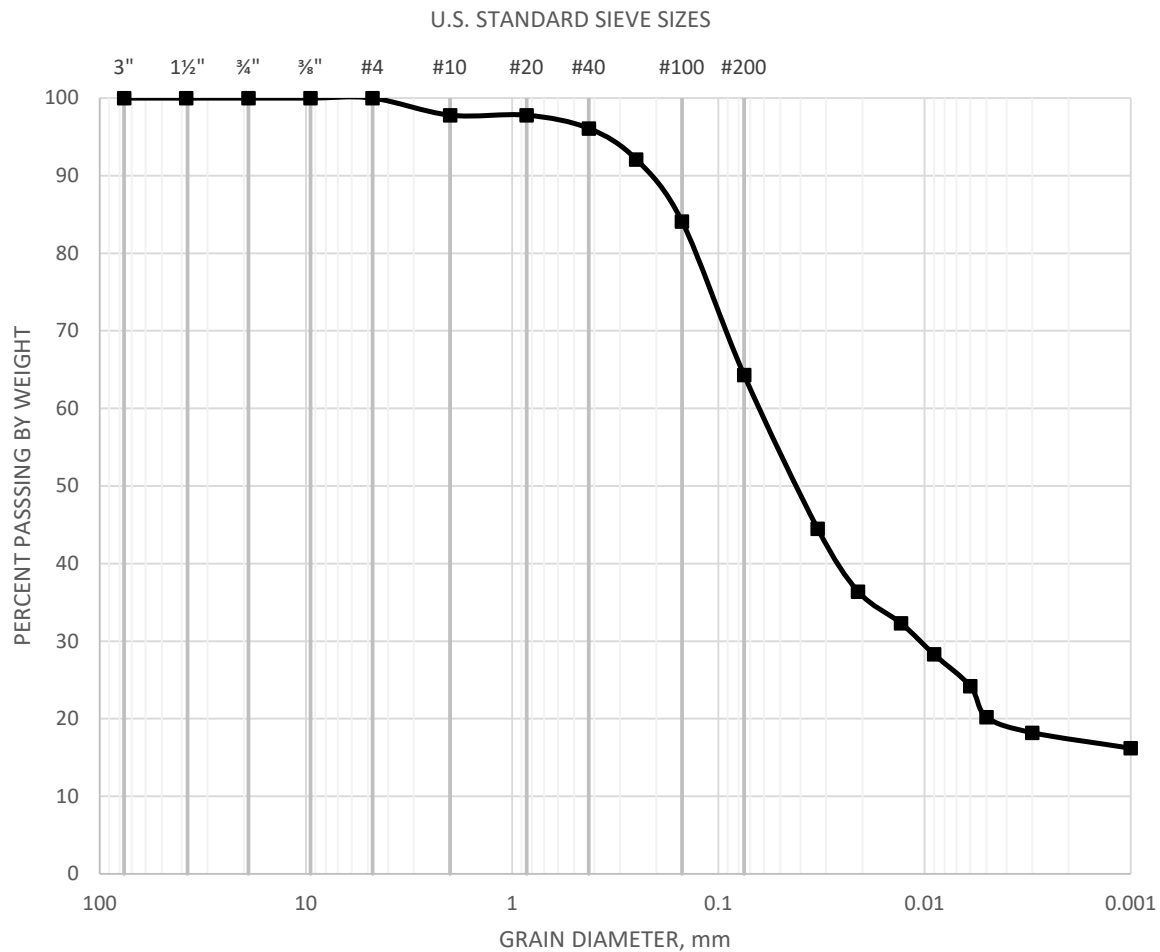
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-9

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	Sand	Silt	Clay
		%		
B-2@15	Sandy SILT (ML) with some clay, dark brown	35.7	44.1	20.2



GEOCON

GRAIN SIZE DISTRIBUTION WITH HYDROMETER

ASTM D-422

Checked by: ADL

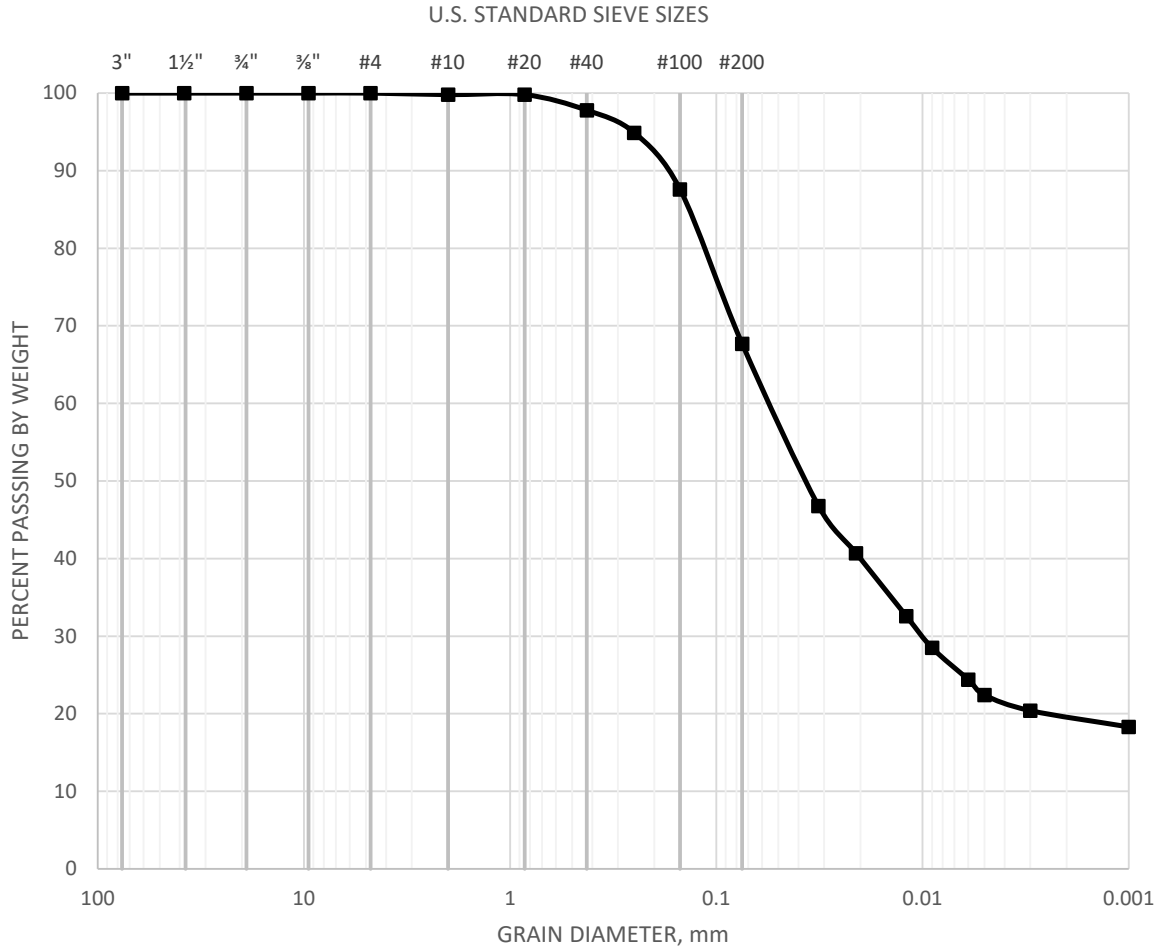
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

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Figure B-10

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	Sand	Silt	Clay
		%		
B-3@10	Sandy SILT (ML) with some clay, grayish brown	32.3	45.3	22.4



GEOCON

GRAIN SIZE DISTRIBUTION WITH HYDROMETER

ASTM D-422

Checked by: ADL

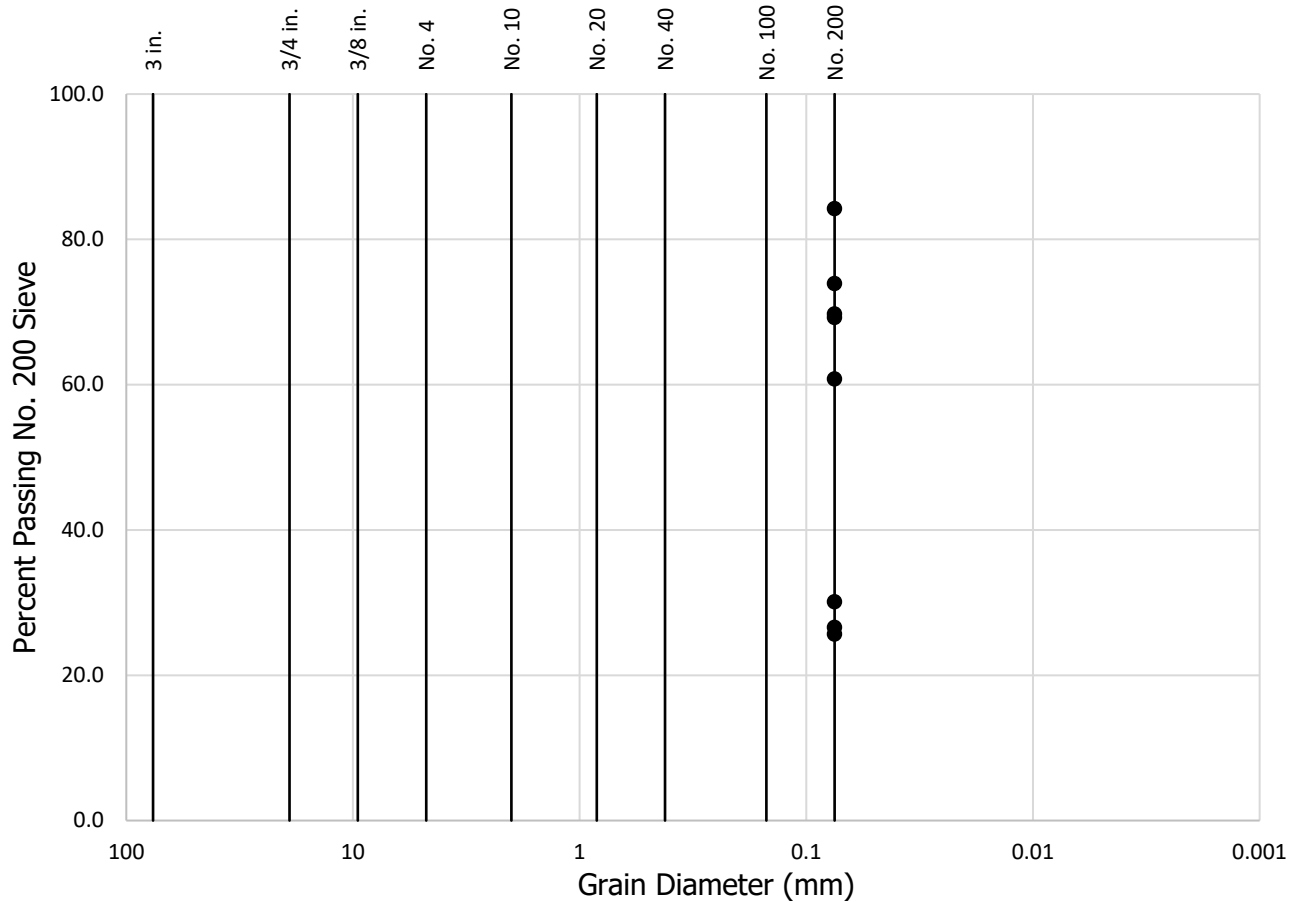
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 24

Figure B-11

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B-1 @ 5'	60.8
B-1 @ 7.5'	26.6
B-1 @ 10'	84.2
B-1 @ 12.5'	69.2
B-1 @ 20'	30.1
B-1 @ 22.5'	25.7
B-1 @ 25'	73.9
B-1 @ 27.5'	69.7



GRAIN SIZE ANALYSIS

ASTM D-1140

Checked by: ADL

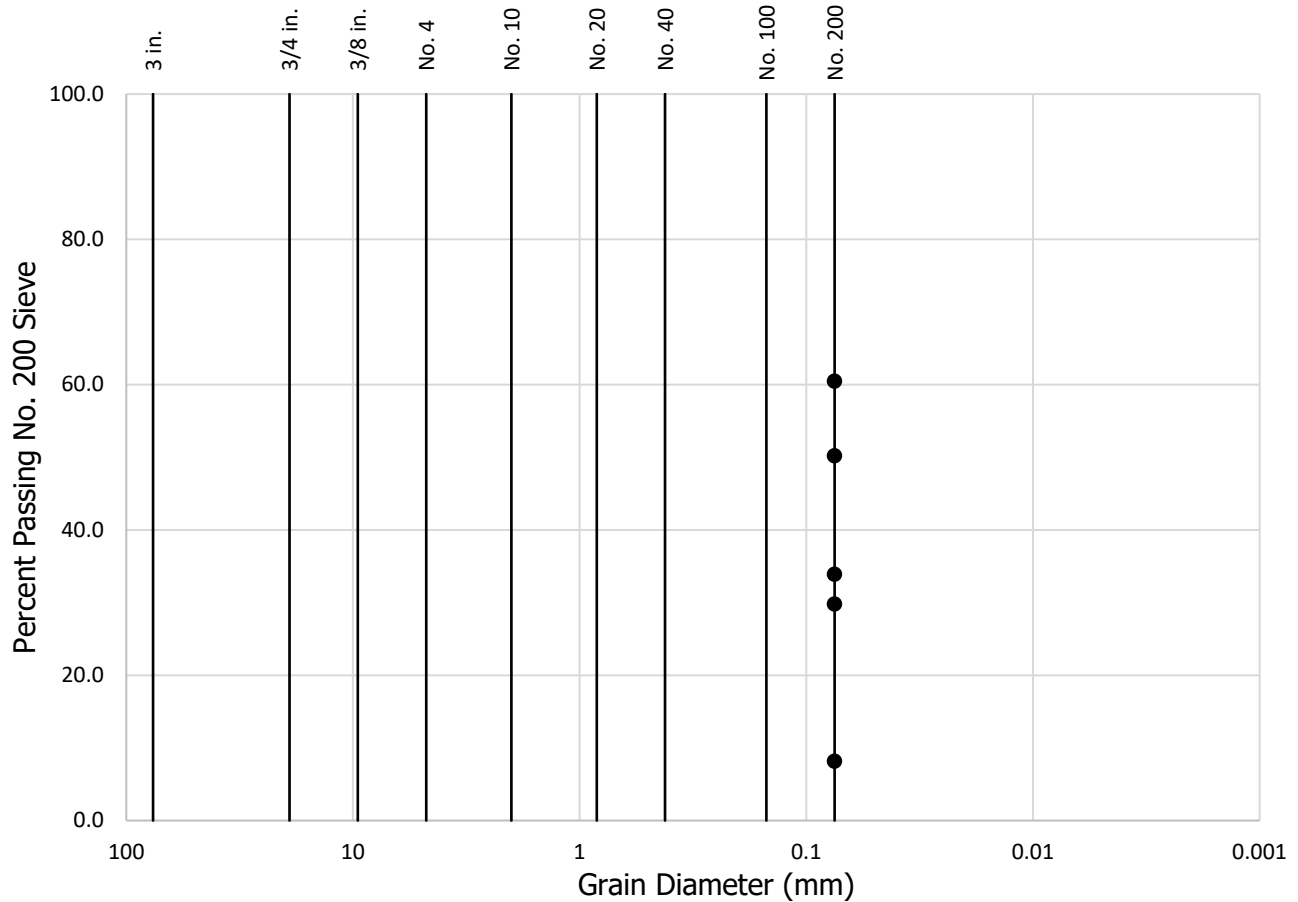
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-12

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B-1 @ 30'	8.2
B-1 @ 35'	33.9
B-1 @ 40'	50.2
B-1 @ 45'	60.5
B-1 @ 50'	29.8



GRAIN SIZE ANALYSIS

ASTM D-1140

Checked by: ADL

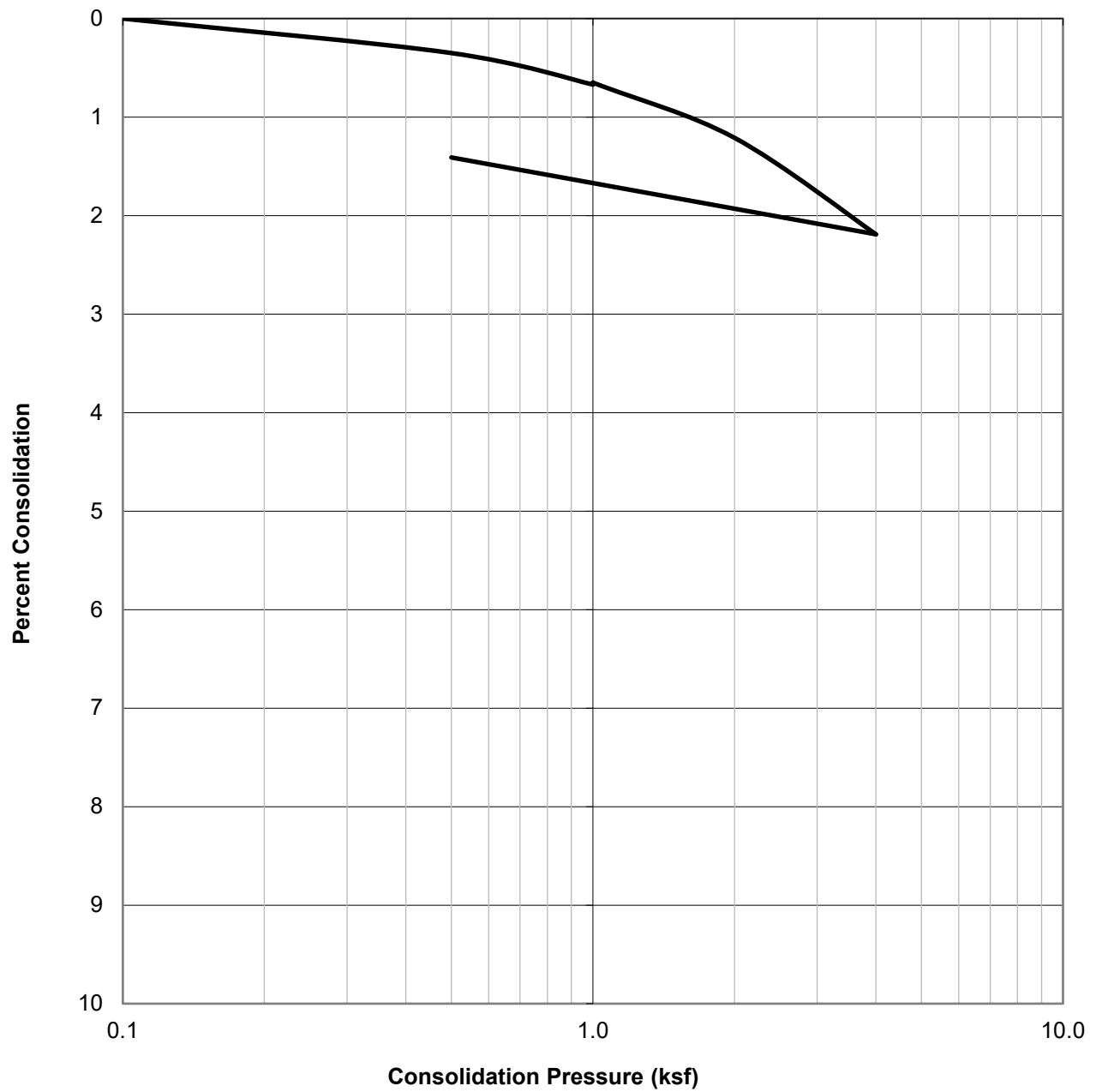
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-13

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-3@5	Silty SAND (SM), brown	117.9	14.9	16.9



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: ADL

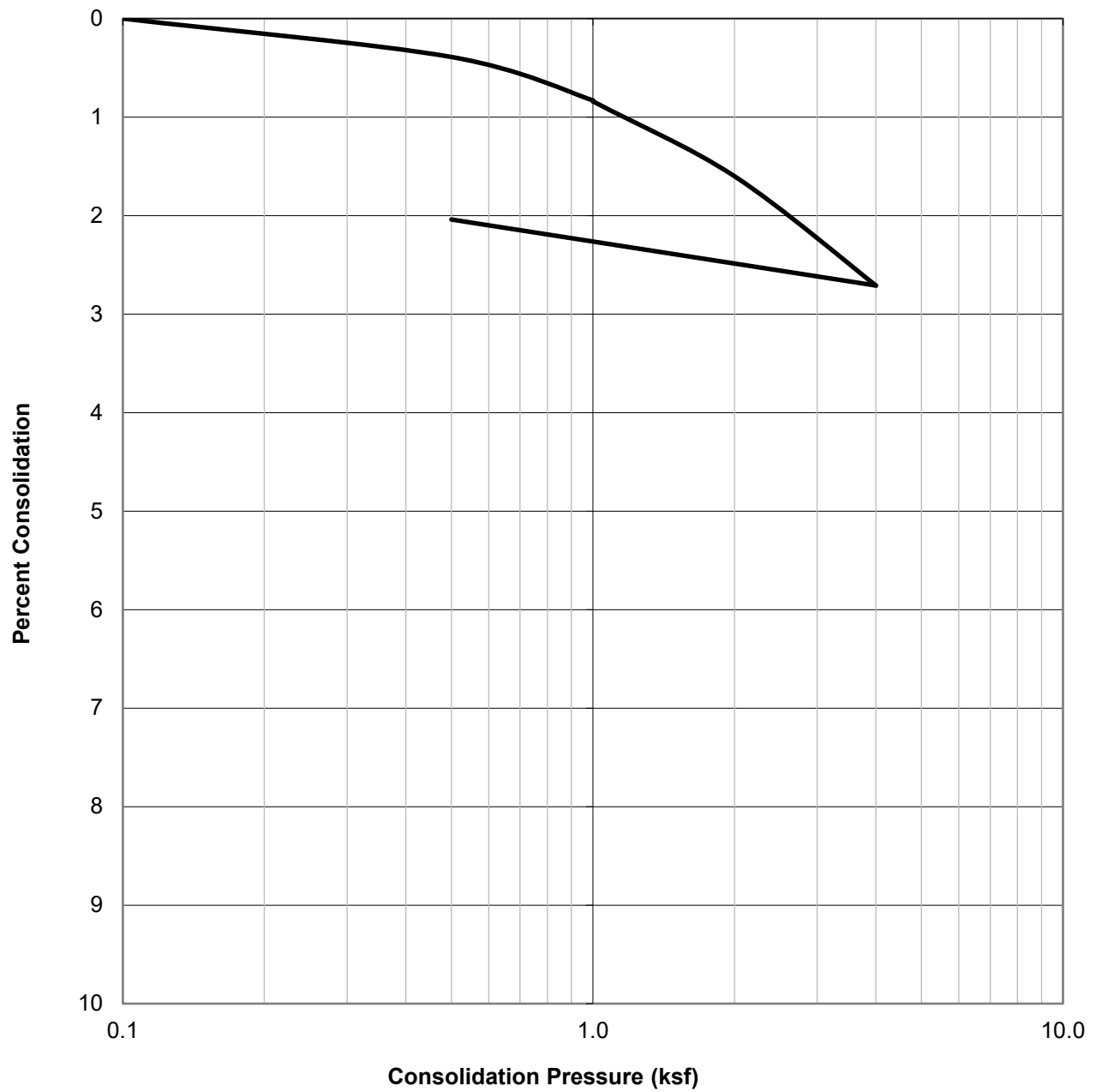
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-14

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-3@7.5	Silty SAND (SM), dark brown	107.9	19.7	21.2



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: ADL

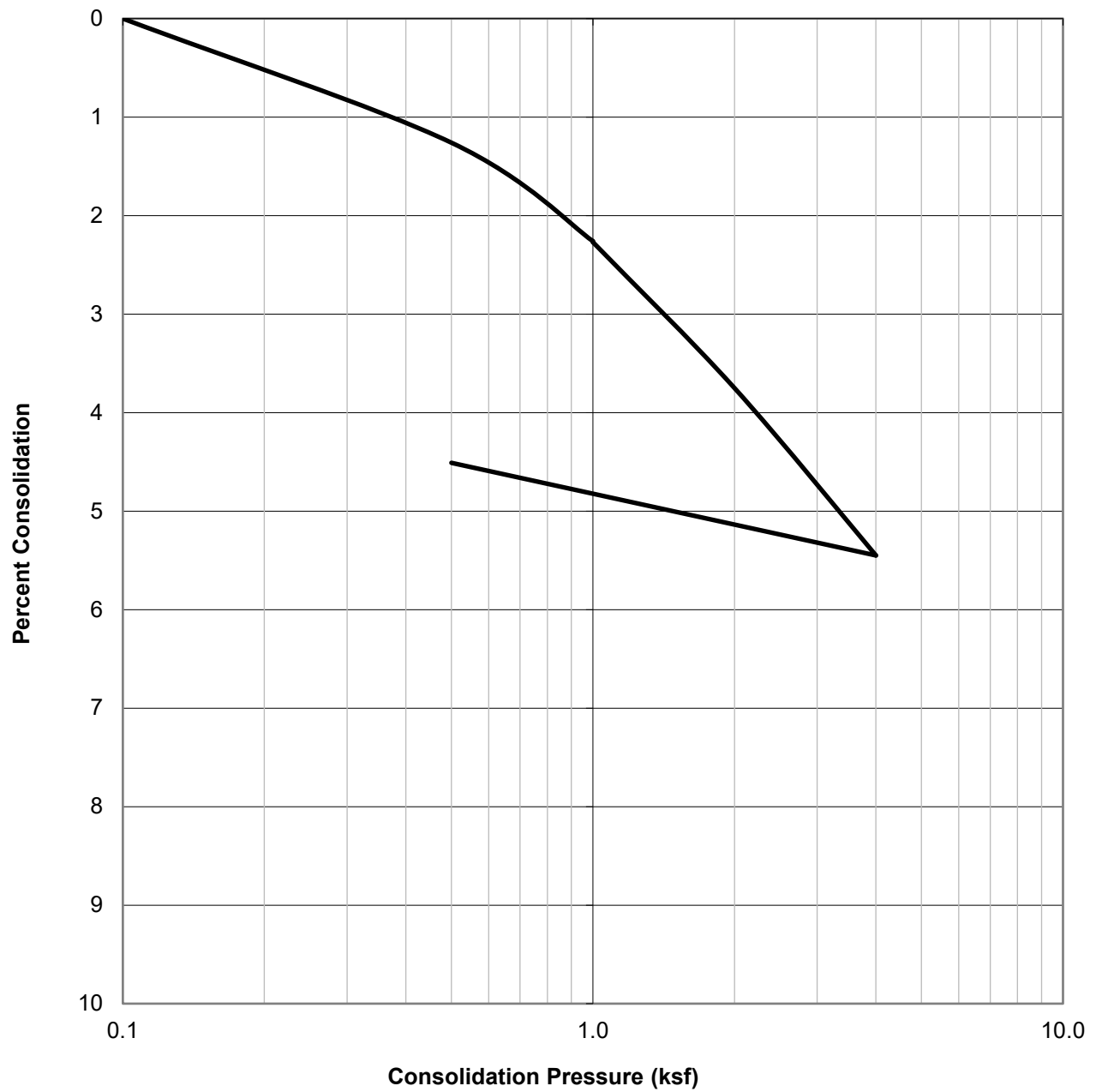
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-15

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-3@10	Sandy SILT (ML), brown	101.7	25.5	25.6



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: ADL

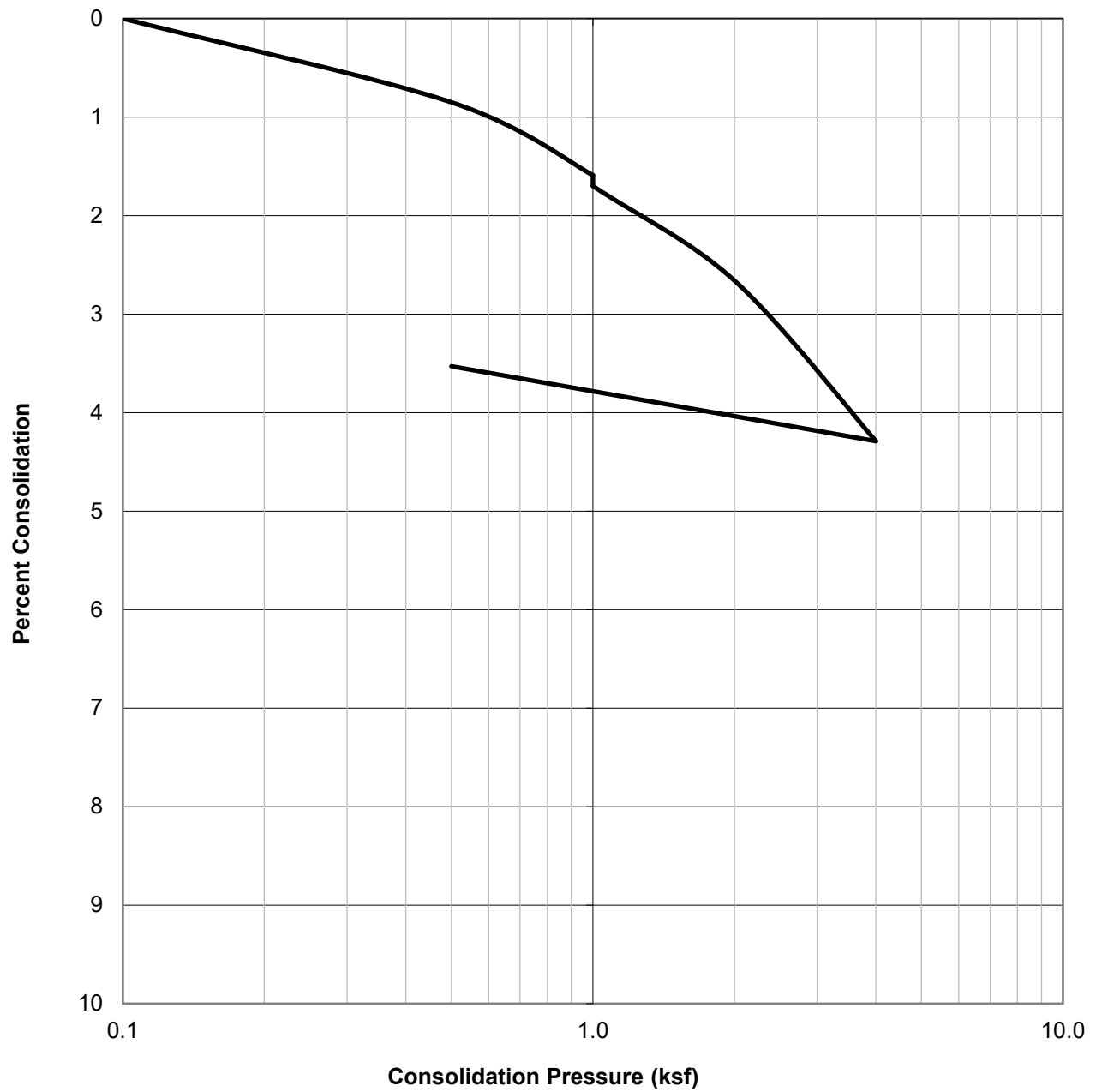
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-16

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-4@5	Silty SAND (SM), dark brown	114.7	18.0	18.5



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: ADL

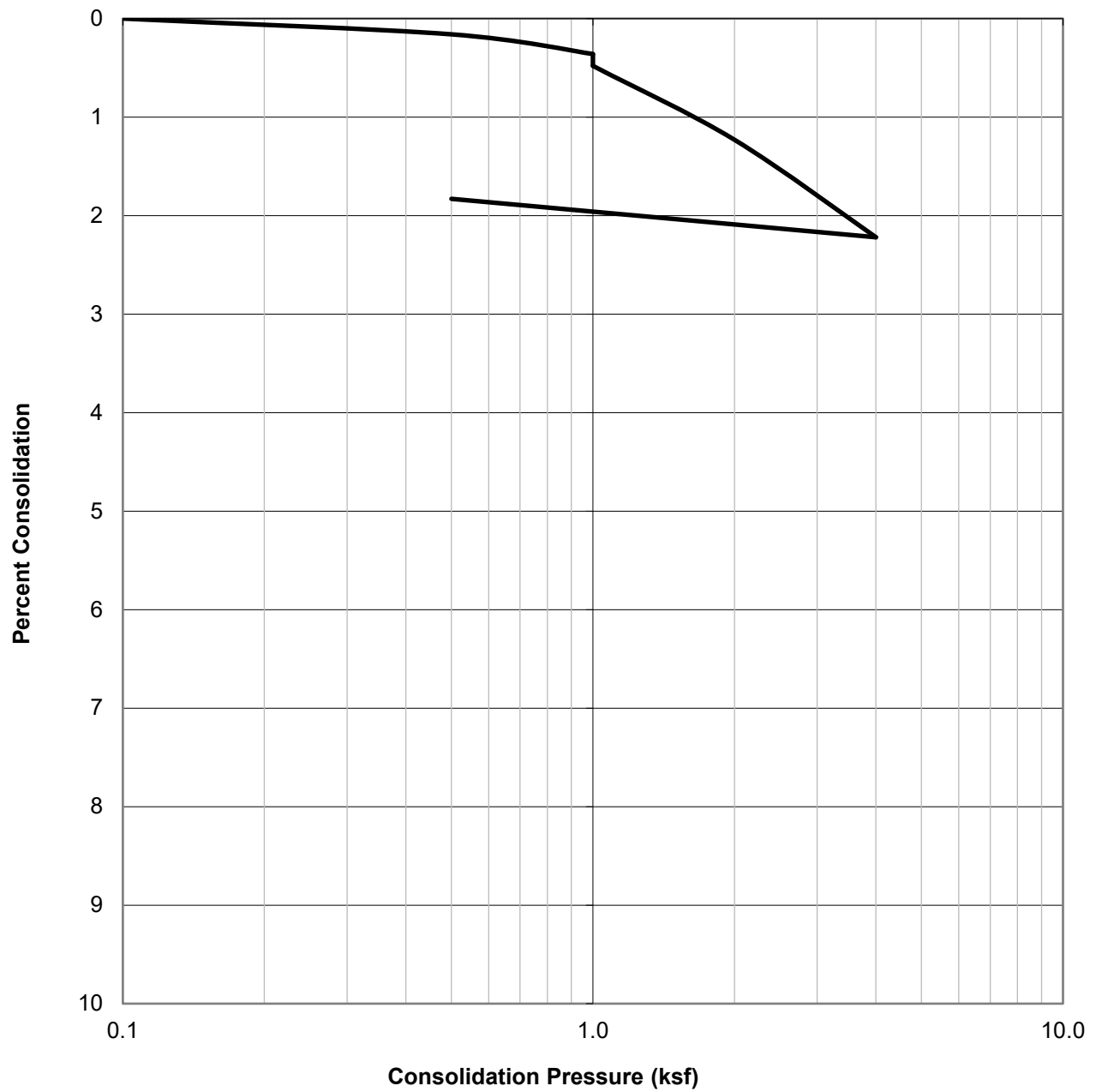
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-17

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-4@7.5	Silty SAND (SM), brown	102.9	10.8	19.1



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: ADL

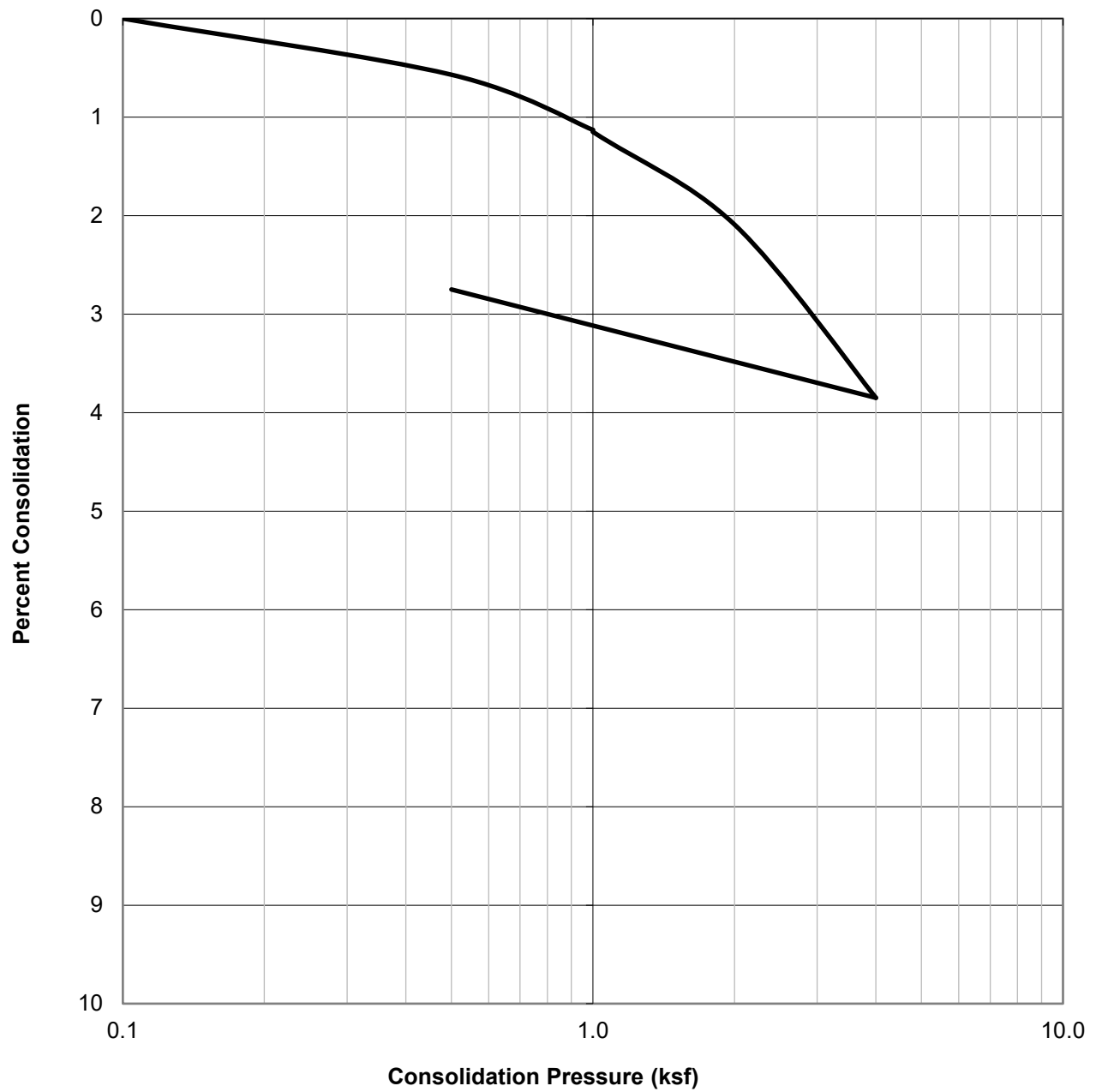
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-18

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B-4@10	Silty SAND (SM), brown	95.4	28.3	29.2



CONSOLIDATION TEST RESULTS

ASTM D-2435

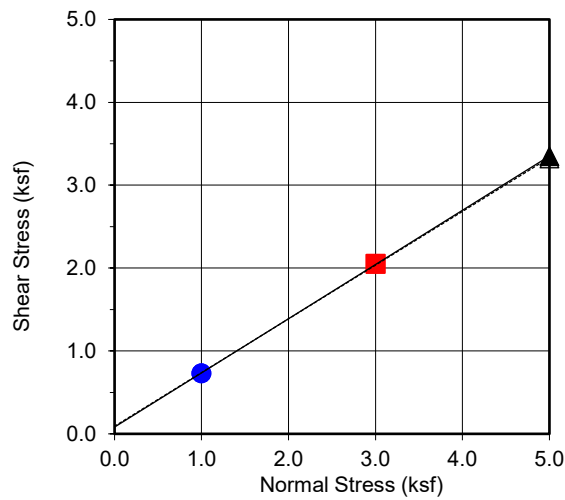
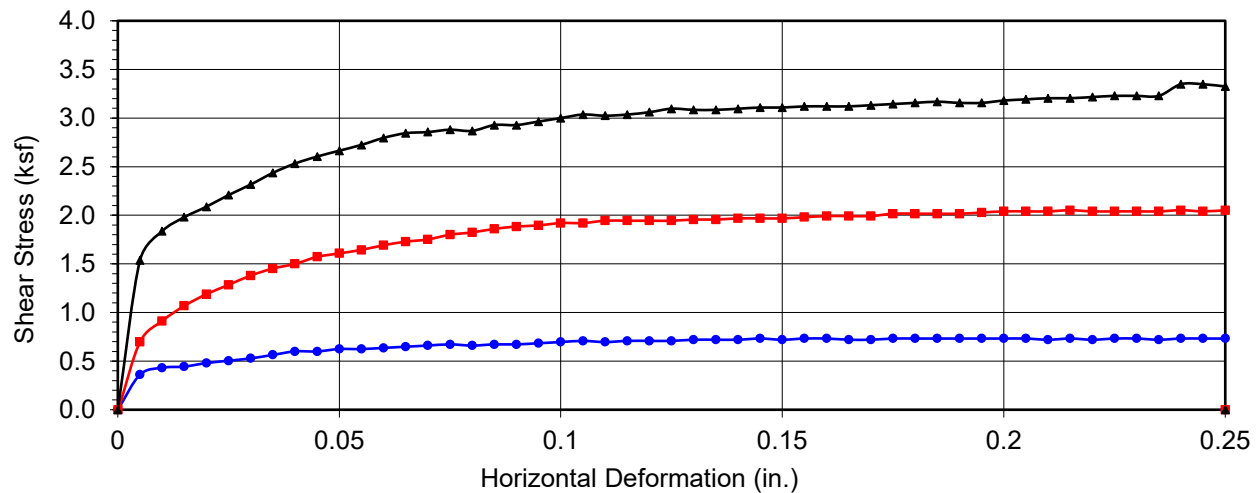
Checked by: ADL

Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-19



Boring No.	B-1
Sample No.	B-1@0-5
Depth (ft)	0-5
<u>Sample Type:</u>	Bulk

<u>Soil Identification:</u>		
Silty SAND (SM), brown		
<u>Strength Parameters</u>		
	C (psf)	ϕ ($^{\circ}$)
Peak	82	33
Ultimate	92	33

Normal Stress (kip/ft ²)	1	3	5
Peak Shear Stress (kip/ft ²)	● 0.73	■ 2.05	▲ 3.35
Shear Stress @ End of Test (ksf)	○ 0.73	□ 2.05	△ 3.32
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.9	8.1	8.0
Initial Dry Density (pcf)	115.0	114.9	114.9
Initial Degree of Saturation (%)	45.8	47.0	46.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	21.6	19.8	12.1



DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

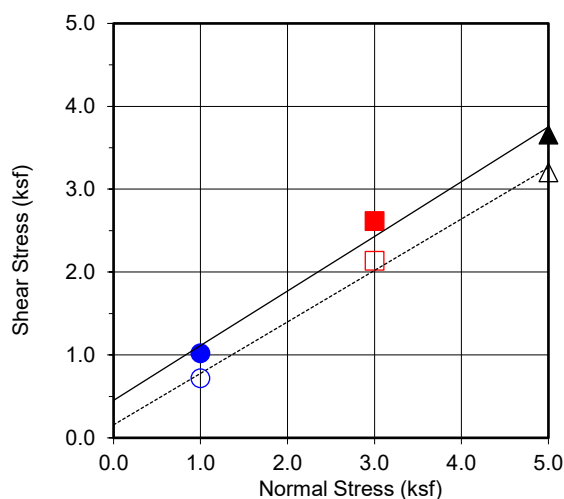
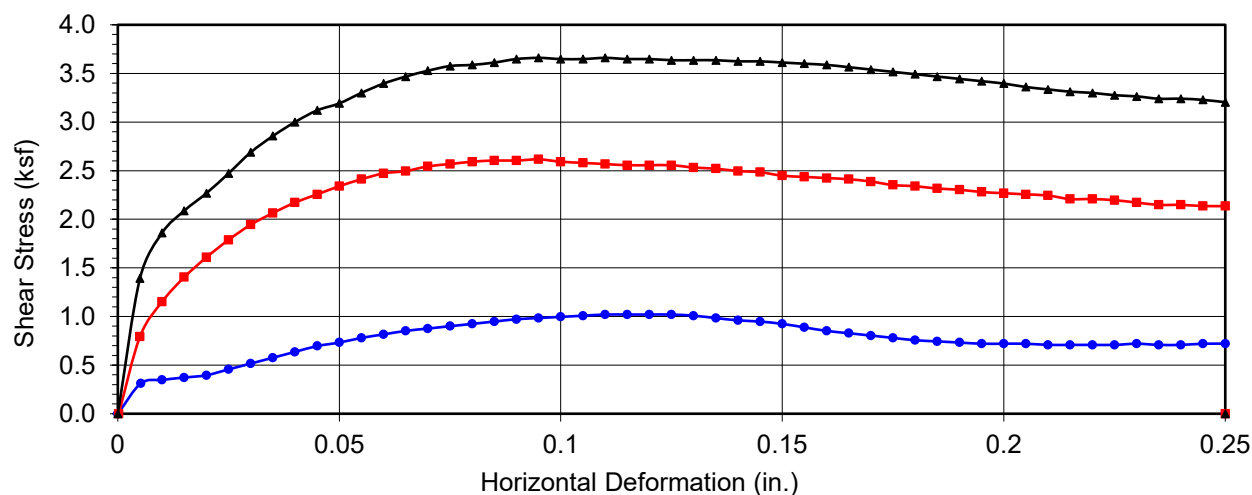
Checked by: ADL

Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-20



Boring No.	B-2
Sample No.	B-2@2.5
Depth (ft)	2.5
<u>Sample Type:</u>	Ring

<u>Soil Identification:</u>		
Silty SAND (SM), brown		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	452	33
Ultimate	157	32

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.02	■ 2.62	▲ 3.66
Shear Stress @ End of Test (ksf)	○ 0.72	□ 2.14	△ 3.20
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	12.7	12.8	13.9
Initial Dry Density (pcf)	120.7	124.1	121.1
Initial Degree of Saturation (%)	86.1	96.9	95.9
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	16.3	16.0	16.2



DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

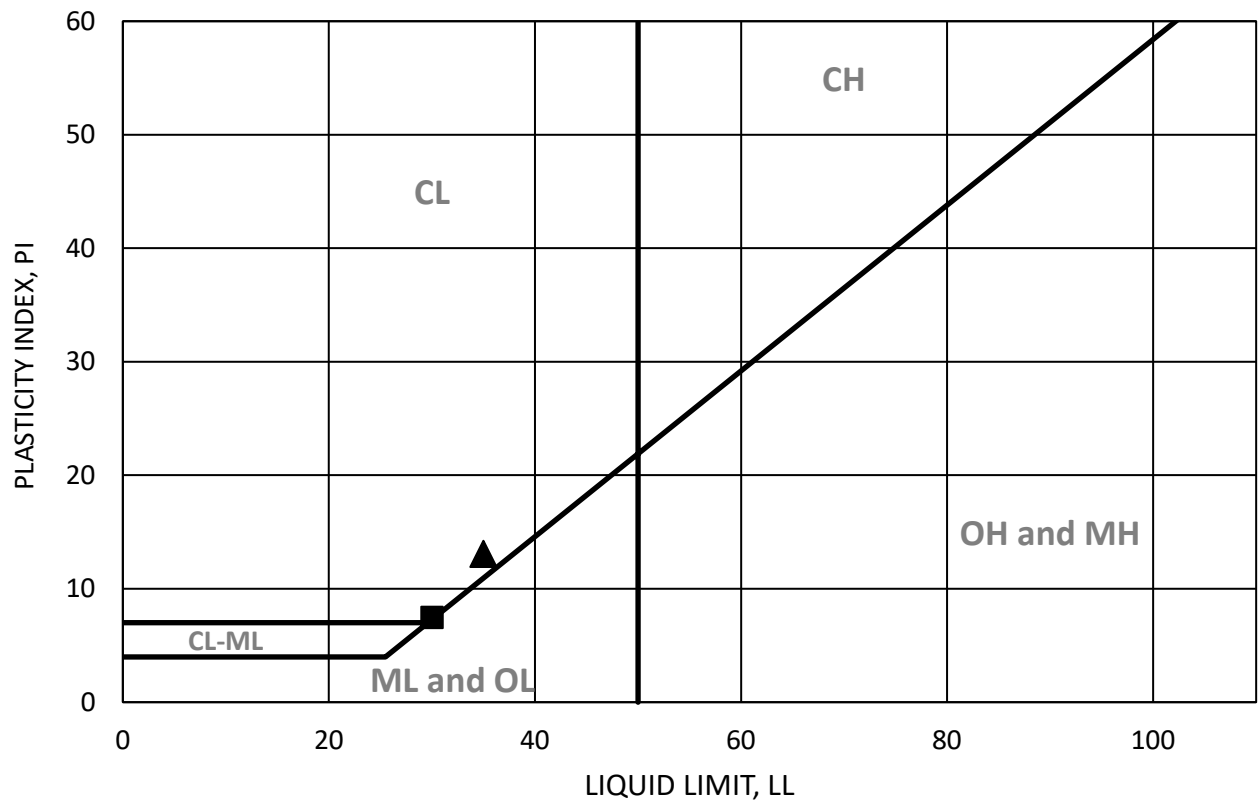
Checked by: ADL

Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-21



SYMBOL	BORING	DEPTH (ft)	LL	PL	PI	MOISTURE CONTENT AT SATURATION	SOIL BEHAVIOR
■	B-1	12.5	30	23	7		CL
◆	B-1	27.5	N/P	N/P	N/P		N/P
▲	B-1	40	35	22	13		CL
●	B-1	45	N/P	N/P	N/P		N/P
□	B-1	50	N/P	N/P	N/P		N/P
◇							
△							
○							

N/P = Non-Plastic



ATTERBERG LIMITS

ASTM D-4318

Checked by: ADL

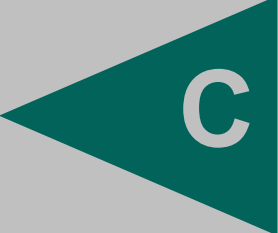
Project No.: T2652-22-20

Gym & Garage with Storage, Fire Station 73
27415 Enterprise Circle, Temecula California

February 2024

Figure B-22

APPENDIX



C

APPENDIX C

LIQUEFACTION AND LATERAL SPREAD ANALYSIS



Project Name : Temecula Fire Station 73

Project No : T2652-22-20

Boring : B-1

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.88
Peak Horiz. Acceleration PGA_M (g):	0.778
Magnitude Scaling Factor:	1.247
Historic High Groundwater:	10.0
Groundwater Depth During Exploration:	12.5

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N_{60} :	1.25
Rod Len.Corr.(CR) (0-no or 1-yes):	1
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use K_{sigma} (0-no or 1-yes):	1

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf):	62.4

Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	Field SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)	Est. Dr (%)	CN Factor	Corrected (N1)60cs	Eff. Unit Wt. (psf)	Resist. CRR 7.5	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	136.7	0	12.6	1.0	1		86	1.700	24.1	136.7	0.275	1.000	0.506	--
2.0	123.3	0	12.6	2.0	1	0	83	1.700	24.1	123.3	0.275	0.998	0.505	--
3.0	123.3	0	12.6	3.0	1	0	81	1.700	24.1	123.3	0.275	0.996	0.504	--
4.0	123.3	0	12.6	4.0	1	0	79	1.700	24.1	123.3	0.275	0.994	0.503	--
5.0	129.8	0	13.9	5.0	1	61	81	1.700	36.8	129.8	Inf.	0.991	0.501	--
6.0	129.8	0	13.9	6.0	1	61	79	1.700	36.8	129.8	Inf.	0.989	0.500	--
7.5	129.8	0	13.9	7.0	1	61	76	1.555	34.1	129.8	Inf.	0.986	0.499	--
8.0	125.4	0	9.5	8.0	1	61	62	1.500	24.1	125.4	0.276	0.984	0.498	--
9.0	125.4	0	9.5	9.0	1	61	61	1.388	22.7	125.4	0.252	0.982	0.497	--
10.0	125.4	1	9.5	10.0	1	61	60	1.314	21.8	63.0	0.239	0.980	0.509	0.58
11.0	109.8	1	4.4	10.0	1	84	41	1.254	12.5	47.4	0.136	0.978	0.532	0.32
12.5	109.8	1	4.4	10.0	1	84	41	1.214	12.2	47.4	0.133	0.975	0.559	0.30
13.0	100.7	1	4.4	12.5	1	69	40	1.205	12.2	38.3	0.133	0.973	0.568	0.29
14.0	100.7	1	4.4	12.5	1	69	40	1.185	12.1	38.3	0.132	0.972	0.593	0.28
15.0	100.7	1	4.4	12.5	1	69	40	1.170	12.0	38.3	0.131	0.970	0.610	0.27
16.0	125.2	1	8.2	15.0	1	69	54	1.151	18.7	62.8	0.200	0.967	0.626	0.40
17.0	125.2	1	8.2	15.0	1	69	54	1.129	18.4	62.8	0.197	0.965	0.639	0.38
18.0	126.4	1	8.2	17.5	1	69	53	1.108	19.0	64.0	0.203	0.963	0.651	0.39
19.0	126.4	1	8.2	17.5	1	69	53	1.087	18.7	64.0	0.200	0.961	0.661	0.38
20.0	126.4	1	8.2	17.5	1	69	53	1.068	18.5	64.0	0.197	0.958	0.671	0.37
21.0	127.7	1	6.9	20.0	1	30	48	1.050	16.0	65.3	0.170	0.956	0.679	0.31
22.5	127.7	1	6.9	20.0	1	30	48	1.028	15.8	65.3	0.168	0.952	0.688	0.30
23.0	125.4	1	6.9	22.5	1	30	47	1.020	16.1	63.0	0.171	0.949	0.691	0.31
24.0	125.4	1	6.9	22.5	1	30	47	1.000	15.9	63.0	0.169	0.947	0.700	0.30
25.0	125.4	1	6.9	22.5	1	30	47	0.985	15.7	63.0	0.167	0.944	0.705	0.29
26.0	134.2	1	5.0	25.0	1	74	39	0.970	13.3	71.8	0.144	0.940	0.709	0.25
27.0	134.2	1	5.0	25.0	1	74	39	0.955	13.2	71.8	0.143	0.936	0.712	0.24
28.0	134.2	1	5.0	25.0	1	74	39	0.940	13.1	71.8	0.141	0.932	0.715	0.24
29.0	134.2	1	5.0	25.0	1	70	39	0.926	13.0	71.8	0.140	0.928	0.716	0.24
30.0	134.2	1	5.0	25.0	1	70	39	0.913	12.9	71.8	0.139	0.923	0.718	0.23
31.0	138.8	1	18.0	30.0	1	8	70	0.900	25.0	76.4	0.291	0.918	0.718	0.47
32.0	138.8	1	18.0	30.0	1	8	70	0.887	24.6	76.4	0.284	0.912	0.717	0.45
33.0	138.8	1	18.0	30.0	1	8	70	0.874	24.3	76.4	0.278	0.907	0.716	0.44
34.0	138.8	1	18.0	30.0	1	8	70	0.862	23.9	76.4	0.272	0.900	0.715	0.43
35.0	138.8	1	18.0	30.0	1	8	70	0.851	23.6	76.4	0.267	0.894	0.713	0.42
36.0	131.4	1	14.0	35.0	1	34	60	0.840	25.9	69.0	0.310	0.887	0.710	0.49
37.0	131.4	1	14.0	35.0	1	34	60	0.831	25.6	69.0	0.305	0.880	0.708	0.48
38.0	131.4	1	14.0	35.0	1	34	60	0.821	25.4	69.0	0.300	0.872	0.705	0.47
39.0	131.4	1	14.0	35.0	1	34	60	0.812	25.2	69.0	0.296	0.864	0.701	0.46
40.0	131.4	1	14.0	35.0	1	34	60	0.804	25.0	69.0	0.291	0.855	0.697	0.46
41.0	136.1	1	10.0	40.0	1	50	49	0.795	19.3	73.7	0.207	0.846	0.693	0.33
42.0	136.1	1	10.0	40.0	1	50	49	0.786	19.2	73.7	0.205	0.837	0.687	0.33
43.0	136.1	1	10.0	40.0	1	50	49	0.778	19.0	73.7	0.203	0.828	0.682	0.33
44.0	136.1	1	10.0	40.0	1	50	49	0.770	18.9	73.7	0.202	0.818	0.676	0.33
45.0	136.1	1	10.0	40.0	1	50	49	0.762	18.7	73.7	0.200	0.808	0.669	0.33
46.0	138.6	1	20.0	45.0	1	61	66	0.754	32.1	76.2	Inf.	0.798	0.663	Non-Liq.
47.0	138.6	1	20.0	45.0	1	61	66	0.746	31.9	76.2	Inf.	0.788	0.656	Non-Liq.
48.0	138.6	1	20.0	45.0	1	61	66	0.739	31.6	76.2	Inf.	0.778	0.649	Non-Liq.
49.0	138.6	1	20.0	45.0	1	61	66	0.731	31.3	76.2	Inf.	0.768	0.642	Non-Liq.
50.0	138.6	1	14.0	50.0	1	30	54	0.724	22.2	76.2	0.245	0.757	0.634	0.41

Figure C-1



Project Name : Temecula Fire Station 73
Project No : T2652-22-20
Boring : B-1

LIQUEFACTION SETTLEMENT ANALYSIS MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES
EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.88
PGA _M (g):	0.778
Magnitude Scaling Factor:	1.247
Historic High Groundwater:	10.0
Groundwater @ Exploration:	100.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60		LIQUEFACTION SAFETY FACTOR	VOL. STRAIN [e ₁₅] (%)	EQ. SETTLE. Pe (in.)
1.0	13	136.7	0.034	0.034	86	24	0.506	--	0.00	0.00
2.0	13	123.3	0.099	0.099	83	24	0.506	--	0.00	0.00
3.0	13	123.3	0.161	0.161	81	24	0.506	--	0.00	0.00
4.0	13	123.3	0.222	0.222	79	24	0.506	--	0.00	0.00
5.0	14	129.8	0.286	0.286	81	37	0.506	--	0.00	0.00
6.0	14	129.8	0.351	0.351	79	37	0.506	--	0.00	0.00
7.5	14	129.8	0.432	0.432	76	34	0.506	--	0.00	0.00
8.0	9	125.4	0.464	0.464	62	24	0.506	--	0.00	0.00
9.0	9	125.4	0.542	0.542	61	23	0.506	--	0.00	0.00
10.0	9	125.4	0.605	0.589	60	22	0.519	0.58	1.40	0.17
11.0	4	109.8	0.664	0.617	41	12	0.544	0.32	2.30	0.28
12.5	4	109.8	0.732	0.646	41	12	0.573	0.30	2.30	0.41
13.0	4	100.7	0.759	0.657	40	12	0.584	0.29	2.30	0.14
14.0	4	100.7	0.821	0.681	40	12	0.610	0.28	2.30	0.28
15.0	4	100.7	0.872	0.700	40	12	0.630	0.27	2.30	0.28
16.0	8	125.2	0.928	0.726	54	19	0.647	0.40	1.60	0.19
17.0	8	125.2	0.991	0.757	54	18	0.662	0.38	1.70	0.20
18.0	8	126.4	1.054	0.789	53	19	0.676	0.39	1.60	0.19
19.0	8	126.4	1.117	0.821	53	19	0.688	0.38	1.60	0.19
20.0	8	126.4	1.180	0.853	53	18	0.700	0.37	1.70	0.20
21.0	7	127.7	1.244	0.885	48	16	0.711	0.31	1.70	0.20
22.5	7	127.7	1.323	0.926	48	16	0.723	0.30	1.70	0.31
23.0	7	125.4	1.355	0.942	47	16	0.728	0.31	1.70	0.10
24.0	7	125.4	1.434	0.981	47	16	0.739	0.30	1.70	0.20
25.0	7	125.4	1.496	1.013	47	16	0.747	0.29	1.70	0.20
26.0	5	134.2	1.561	1.046	39	13	0.755	0.25	1.80	0.22
27.0	5	134.2	1.628	1.082	39	13	0.761	0.24	1.80	0.22
28.0	5	134.2	1.695	1.118	39	13	0.767	0.24	1.80	0.22
29.0	5	134.2	1.762	1.154	39	13	0.772	0.24	1.80	0.22
30.0	5	134.2	1.829	1.190	39	13	0.778	0.23	1.80	0.22
31.0	18	138.8	1.898	1.227	70	25	0.782	0.47	1.30	0.16
32.0	18	138.8	1.967	1.265	70	25	0.786	0.45	1.30	0.16
33.0	18	138.8	2.036	1.303	70	24	0.790	0.44	1.30	0.16
34.0	18	138.8	2.106	1.341	70	24	0.794	0.43	1.30	0.16
35.0	18	138.8	2.175	1.380	70	24	0.797	0.42	1.30	0.16
36.0	14	131.4	2.243	1.416	60	26	0.801	0.49	1.10	0.13
37.0	14	131.4	2.309	1.451	60	26	0.805	0.48	1.10	0.13
38.0	14	131.4	2.374	1.485	60	25	0.809	0.47	1.10	0.13
39.0	14	131.4	2.440	1.520	60	25	0.812	0.46	1.10	0.13
40.0	14	131.4	2.506	1.554	60	25	0.815	0.46	1.30	0.16
41.0	10	136.1	2.573	1.590	49	19	0.818	0.33	1.60	0.19
42.0	10	136.1	2.641	1.627	49	19	0.821	0.33	1.60	0.19
43.0	10	136.1	2.709	1.663	49	19	0.823	0.33	1.60	0.19
44.0	10	136.1	2.777	1.700	49	19	0.826	0.33	1.60	0.19
45.0	10	136.1	2.845	1.737	49	19	0.828	0.33	1.60	0.19
46.0	20	138.6	2.913	1.775	66	32	0.830	Non-Liq.	0.00	0.00
47.0	20	138.6	2.983	1.813	66	32	0.832	Non-Liq.	0.00	0.00
48.0	20	138.6	3.052	1.851	66	32	0.834	Non-Liq.	0.00	0.00
49.0	20	138.6	3.121	1.889	66	31	0.836	Non-Liq.	0.00	0.00
50.0	14	138.6	3.191	1.927	54	22	0.837	0.41	1.40	0.17

TOTAL SETTLEMENT = 7.2 INCHES

Figure C-2

Seismic Induced Horizontal Deformation/Displacement Analysis

Caltrans Guidelines - Newmark based approach (Bray and Travasarou, 2007)

Temecula Fire Station 73 - Murrieta Creek Embankment Slope

$$D(\text{cm}) = \text{Exp} [-0.22 - 2.83 \ln(k_y) - 0.333 \ln(k_y)^2 + 0.566 \ln(k_y) \text{Log}(PGA) + 3.04 \ln(PGA) - 0.244 \ln(PGA)^2 + 0.278 (M_w - 7)]$$

(A) Sample cases with ----

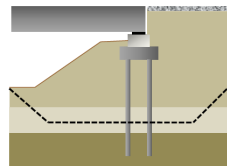
Case	M _w	PGA, g	Log(PGA)	Ln(PGA)	k _y , g	Ln(k _y)	D, cm	D, inch	ky/kmax
1	6.88	0.4946	-0.30575	-0.70401	0.09	-2.45341	17.3	6.8	0.174

Caltrans Guidelines

Newmark based approach (Bray and Travasarou, 2007)

$$D(\text{cm}) = \text{Exp} [-0.22 - 2.83 \ln(k_y) - 0.333 \ln(k_y)^2 + 0.566 \ln(k_y) \text{Log}(PGA) + 3.04 \ln(PGA) - 0.244 \ln(PGA)^2 + 0.278 (M_w - 7)]$$

PGA based on 975 year hazard



Caltrans Guidelines

Foundation restrained ground displacement design case:

$$D(\text{cm}) = \text{Exp} [-0.22 - 2.83 \ln(k_y) - 0.333 \ln(k_y)^2 + 0.566 \ln(k_y) \text{Log}(PGA) + 3.04 \ln(PGA) - 0.244 \ln(PGA)^2 + 0.278 (M_w - 7)]$$

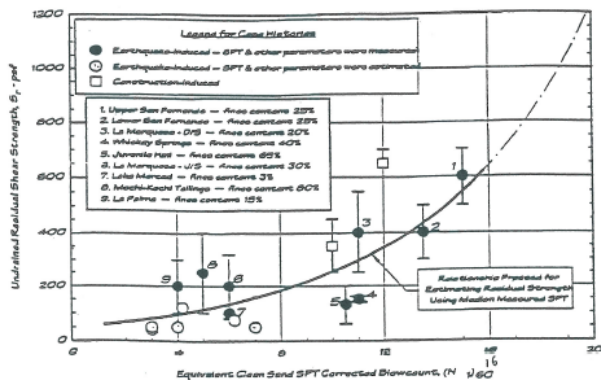
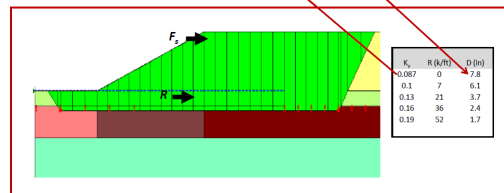


Fig. 14 Undrained Residual Strength, S_r, versus Equivalent Clean Sand SPT Corrected Blowcount Based on Field Case Studies Published by Seed (1987) and by Seed & Harder (1990)

Idriss, August 1998. "Report of Principal Conclusions and Assignments for Further Consensus Building." Notes from NCEER-NSF Workshop on Evaluation of Liquefaction Resistance of Soils, 2nd meeting, Salt Lake City, Utah.

File Name: Temecula Fire Station 73 - Murrieta Creek Yield Acceleration - Block with Footing Load.gsz

Materials:

Name: SM	Model: Mohr-Coulomb	Unit Weight: 130 pcf	Cohesion: 127 psf	Phi: 32 °	Phi-B: 0 °	Piezometric Line: 1
Name: ML	Model: Mohr-Coulomb	Unit Weight: 129 pcf	Cohesion: 100 psf	Phi: 28 °	Phi-B: 0 °	Piezometric Line: 1
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125 pcf	Cohesion: 50 psf	Phi: 35 °	Phi-B: 0 °	Piezometric Line: 1
Name: Liquefiable Zone	Model: Undrained (Phi=0)	Unit Weight: 130 pcf	Cohesion: 500 psf			Piezometric Line: 1

Loads:

Horz Seismic Load: 0.086 (ky)

Surcharge (Building) Load: 200 pcf x 11.33 ft high

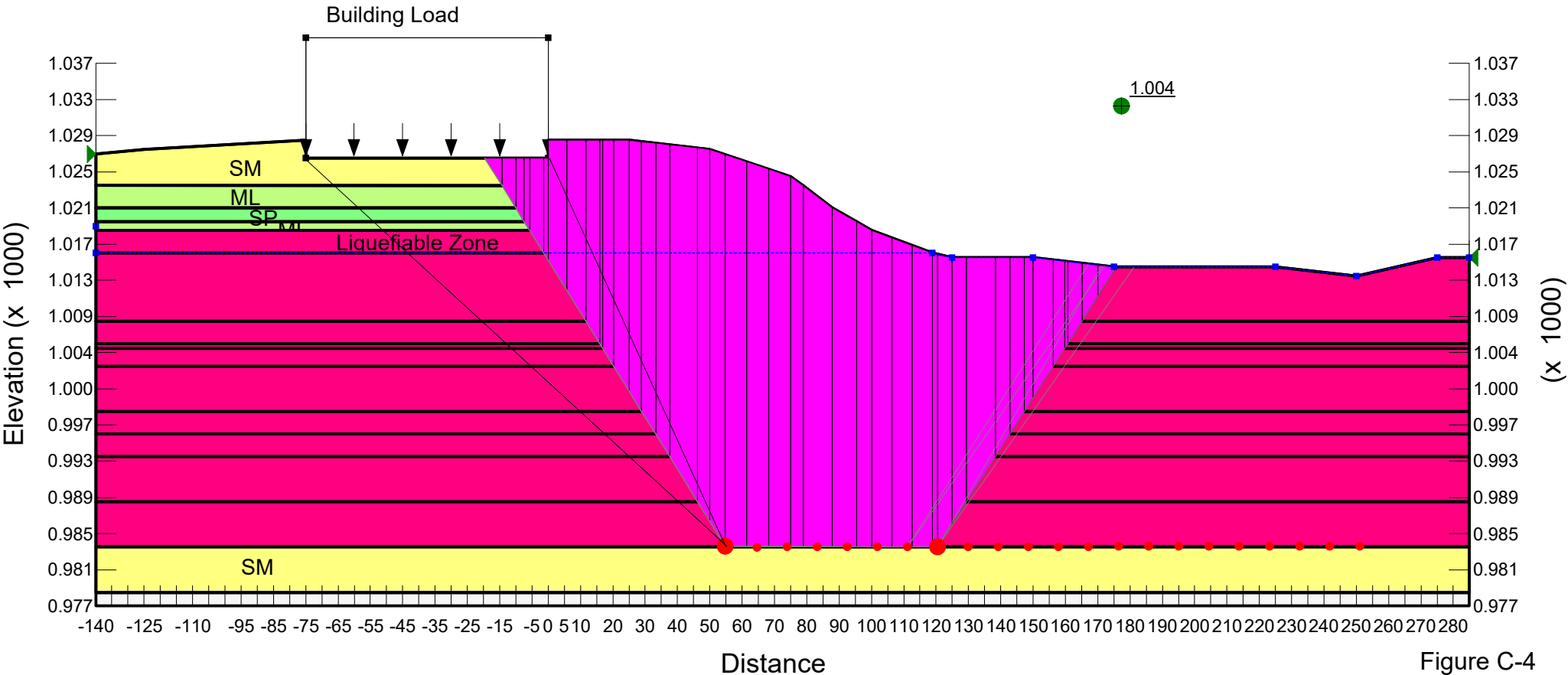


Figure C-4

APPENDIX

D

APPENDIX D
RECOMMENDED GRADING SPECIFICATIONS

FOR

GYM & GARAGE WITH STORAGE
FIRE STATION 73
27415 ENTERPRISE CIRCLE
TEMECULA, CALIFORNIA

PROJECT NO. T2652-22-20

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

- 1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.
- 1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.
- 1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

- 2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.
- 2.2 **Contractor** shall refer to the Contractor performing the site grading work.
- 2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.
- 2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

- 2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.
- 2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.
- 2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

- 3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.
- 3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than $\frac{3}{4}$ inch in size.
- 3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.
- 3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than $\frac{3}{4}$ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.
- 3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.
- 3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9

and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

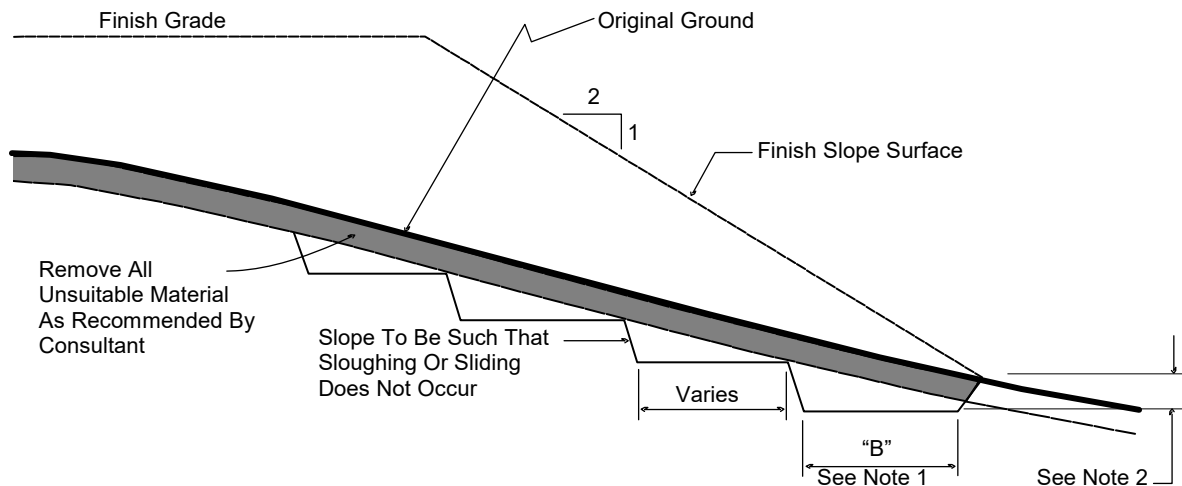
- 3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.
- 3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.
- 3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition

4. CLEARING AND PREPARING AREAS TO BE FILLED

- 4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.
- 4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

- 4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.
- 4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

- DETAIL NOTES:
- (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.
 - (2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

- 4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

- 5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.
- 5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

- 6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:
 - 6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.
 - 6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.
 - 6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.
 - 6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.
 - 6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

- 6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.
 - 6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.
 - 6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.
- 6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:
- 6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.
 - 6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.
 - 6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.
 - 6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

- 6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.
- 6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.
- 6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:
- 6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.
- 6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.
- 6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection

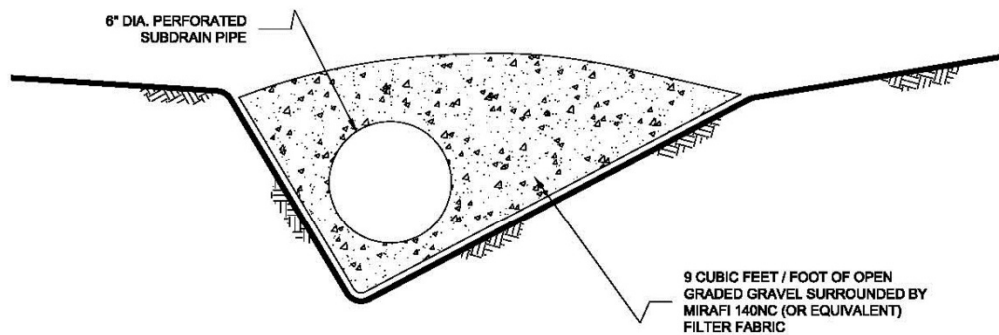
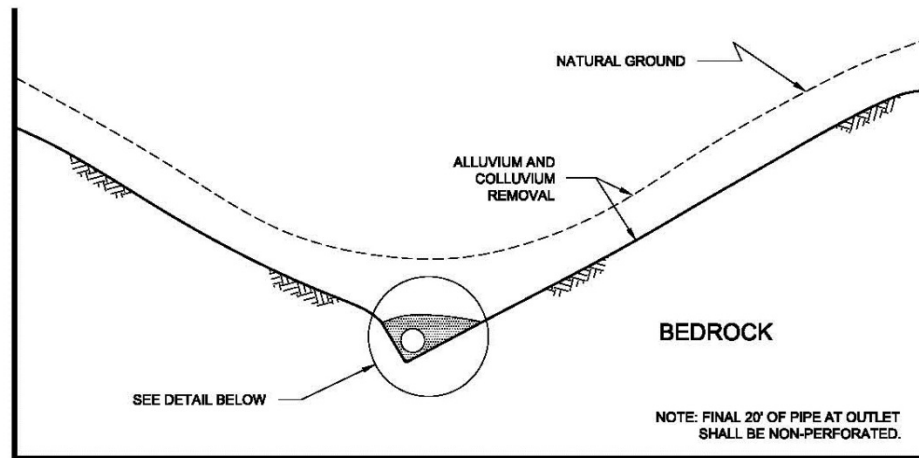
variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

- 6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of “passes” have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.
- 6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.
- 6.3.6 To reduce the potential for “piping” of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.
- 6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

- 7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL



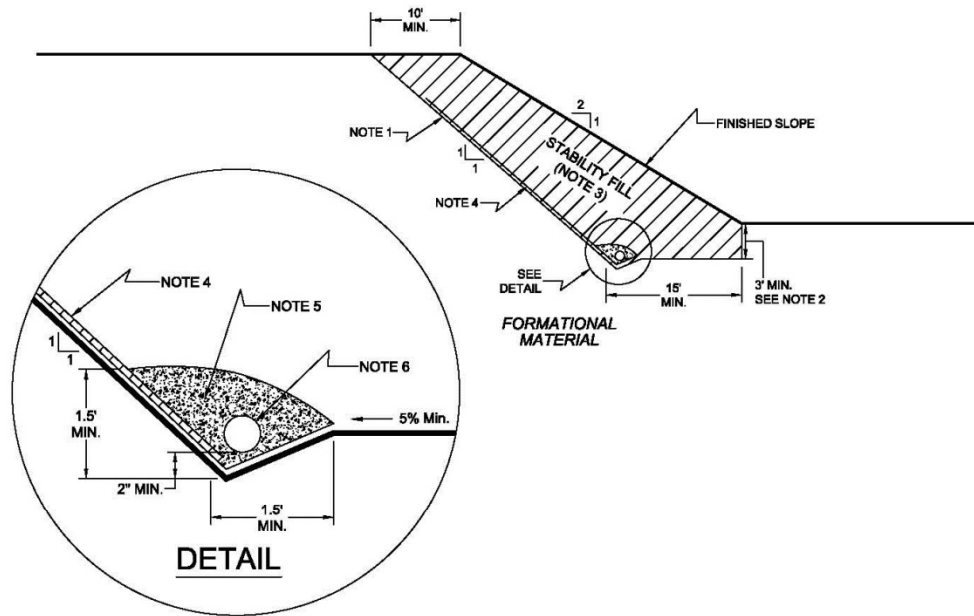
NOTES:

- 1.....8-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.
- 2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or larger) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

- 1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).
- 2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.
- 3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.
- 4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.
- 5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).
- 6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

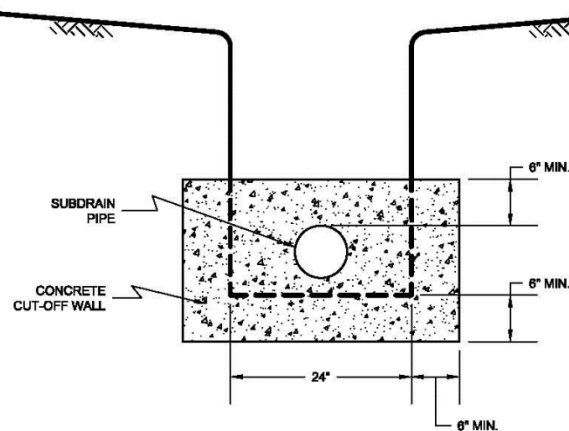
NO SCALE

- 7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.
- 7.4 *Rock fill or soil-rock fill* areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock fill* drains should be constructed using the same requirements as canyon subdrains.

- 7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

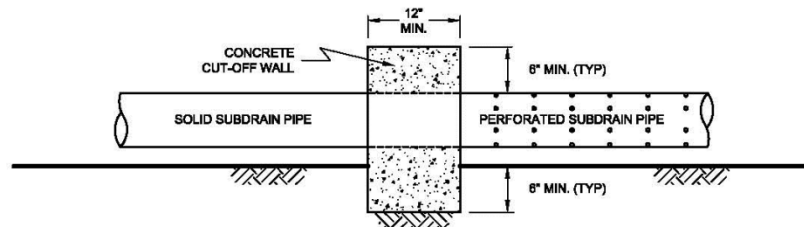
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW

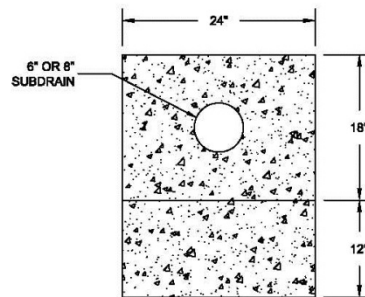


NO SCALE

- 7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

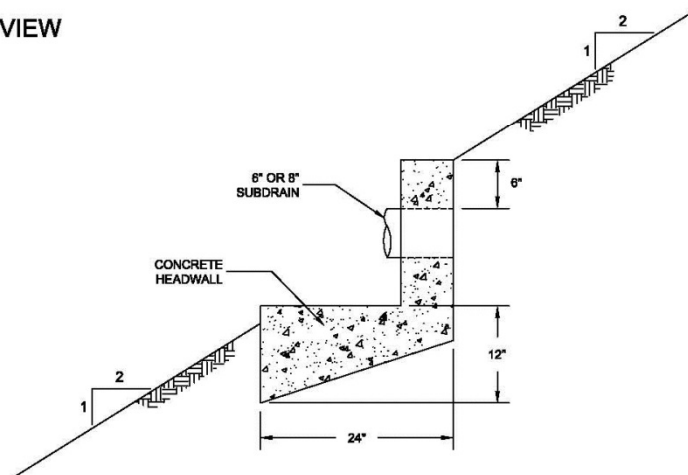
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

- 7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an “as-built” map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

- 8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.
- 8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.
- 8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.
- 8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.
- 8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.
- 8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

- 8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method*.

- 8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)*.
- 8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.
- 8.6.1.4 Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

- 9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.
- 9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

- 10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.
- 10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

CITY OF TEMECULA, DEPARTMENT OF PUBLIC WORKS
**EXHIBIT “B” – TRAFFIC CONTROL PLAN GENERAL NOTES, GUIDELINES &
CHECKLIST**
for
FIRE STATION 73 NEW APPARATUS BAY AND GYM
PROJECT NO. PW19-13

Capital Improvement Program

Traffic Control Plan General Notes

41000 Main Street
Temecula, CA 92590
Phone: 951-694-6444

www.temeculaca.gov



1. All traffic control devices shall conform to the latest edition of the California Manual on Uniform Traffic Control Devices (California MUTCD) and the Standard Specifications for Public Works Construction.
2. The City Engineer or his/her representative has the authority to initiate field changes to ensure public safety.
3. All traffic control devices shall be removed from view when not in use.
4. Unless otherwise permitted, Work hours shall be restricted to the period between 7:00 a.m. and 4:00 p.m., Monday through Friday. When night work is required, work hours shall be 9:00 p.m. to 5:00 a.m., Sunday through Thursday.
5. Trenches must be backfilled or plated during non-working hours. Steel plates shall have an asphaltic concrete berm on all edges. All dirt, dust, and debris shall be removed from the street at the end of each day and at the end of the job. The street shall always be in drivable condition.
6. Pedestrian controls shall be provided as shown on the Plans.
7. Temporary "NO PARKING" signs will be posted 24 hours prior to commencing the Work.
8. Access to driveways shall always be maintained unless other arrangements are made in coordination with the property owner and the City.
9. The Contractor shall replace within 72 hours; all traffic signal loop detectors damaged during construction.
10. The Contractor shall replace within 24 hours, all striping removed or damaged by the Work. (Striping may be replaced temporarily with tape.)
11. All Workers shall be equipped with an orange vest (or a reflective vest at night). All flaggers shall also be equipped with a hard hat, C28 "Stop/Slow" paddle, and shall be trained in the proper fundamentals of flagging traffic.
12. Any work that disturbs normal traffic signal operations shall be coordinated with the City of Temecula's Traffic Division, 48 hours prior to beginning construction. Contact the City's Traffic Division at (951) 694 -6411.
13. The Contractor shall maintain all traffic control devices 24 hours per day and 7 days per week.
14. A minimum of twelve (12) foot travel lanes must be maintained unless otherwise approved by the Department of Public Works.

Capital Improvement Program

Traffic Control Plan General Notes

41000 Main Street
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15. All night work will require written approval from the Department of Public Works. Lane closures, road detours, road closures, and traffic signal modifications associated with overnight construction activities will require warning signs to be posted at least one week before construction begins.
16. A solar-powered flashing arrow board shall be required on all arterial street lane closures.
17. If the Contractor determines that conduit installation will be by the boring machine method, the trench patch for the utility observation excavation will be the same as for the open trench excavation method. The Contractor shall provide a single continuous surface restoration, eliminating multiple penetrations into the public roadway, meeting all requirements in City Standard Drawing # 407 (reference all sheets) for the trench patch.
18. Any work that creates an undue safety risk or creates severe congestion may be shut down by City Traffic Engineers, City Field Inspection, or the Police Department.
19. Cones and delineators shall have reflectorized sleeves for night work.
20. If parking is allowed in an advance warning area, advance warning signs shall be mounted on high-level devices.

THE CONTRACTOR IS RESPONSIBLE FOR FULL AND COMPLETE REPRESENTATION OF THE ACTUAL ROAD CONDITIONS SHOWN ON THE PLANS PREPARED BY THE CONTRACTOR, INCLUDING, BUT NOT LIMITED TO, EXISTING STRIPING, SIGNING, SIDEWALKS, AND BIKE LANES.

Revision: 05/04/2026

Land Development

Traffic Control Plan Guidelines & Checklist

41000 Main Street
Temecula, CA 92590
Phone: 951-694-6444
www.temeculaca.gov



The basic objective of each traffic control plan (TCP) is to permit the contractor to work within the public right of way efficiently, effectively and causing the least inconvenience to the public while maintaining a safe, uniform flow of traffic. The construction work and the public traveling through the work zone in vehicles, bicycles or as pedestrians must be given equal consideration when developing a traffic control plan.

A TCP shall be required for all work performed within the public right-of-way. Each traffic control plan shall be developed consistent with the latest edition of the [California Manual on Uniform Traffic Control Devices](#) (CA-MUTCD), as specified in the Guidelines below. The information included on a traffic control plan will vary depending upon the complexity of the project, the volume of traffic affected and the roadway geometrics and the posted speed where the construction is being performed. The TCP must clearly depict the exact sequence of the construction operations, the construction to be performed, and the traveled way that will be utilized by all movements of traffic during each phase of construction. Multiple phases of construction will require a separate traffic control plan for each different construction phase or stage operation.

The purpose of our Guidelines is to ensure that all of the basic elements of traffic control are included on the plan and are clear to the reviewers and implementers in the field and to facilitate processing and archiving of the documents. This will help expedite the plan review process. Following the submittal of traffic control plans, all submittals deemed complete shall be reviewed within three (3) weeks.

A traffic control plan that does not include each of the appropriate elements listed below will be deemed incomplete and returned for revision and re-submittal. Traffic control plans shall be submitted in a timely manner to allow for the specified review period. It is important to note that each TCP must be developed specific to the actual construction work zone location. Approved traffic control plan will be reviewed at the pre-construction conference.

TRAFFIC CONTROL PLAN CRITERIA

- Follow City Guidelines, see below
- Include City General Notes on TCP, with Revision Date, see below
- Include City Signature Block (scale to approximately 5x2" to allow space for signatures)
- Include the Certificate of Responsible Charge statement on the Title sheet, and Sign and Stamp each sheet

CITY OF TEMECULA	
RECOMMENDED BY	DATE:
ACCEPTED BY ERICK ESCOBEDO TRAFFIC ENGINEER R.T.E. NO: 3002	DATE

Land Development

Traffic Control Plan Guidelines & Checklist

41000 Main Street
Temecula, CA 92590
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www.temeculaca.gov



ENGINEER OF WORK'S CERTIFICATE

I, _____ hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and the design is consistent with current standards and the City of Temecula.

I, understand that the check of project drawings and specifications by the City of Temecula is confined to a review only and does not relieve me of responsibilities for the project design.

Signature _____ Date _____

R.C.E./R.T.E. No. _____ Exp. _____

Firm _____

Address _____

Telephone No. _____

TRAFFIC CONTROL PLAN CHECKLIST

1. TCP shall be drawn on 24" x 36", unless otherwise approved by the Department of Public Works. **TCP's prepared for work occurring on streets shown on the Circulation Element of the General Plan shall be:**
 - **Prepared to scale on 24" x 36" plan sheets,**
 - **Signed and Stamped by a Registered Civil Engineer or Registered Traffic Engineer,**
 - **Final submission shall be in accordance with the online submittal requirements.**
2. TCP must use legible lettering and clear, contrasting, symbols for viewing or printing.
3. In some cases, where field conditions match **exactly**, a Standard Template as shown on the City web site in the **Improvement Standard Drawings** web page may be used, in lieu of a custom TCP, as approved by the Director of Public Works.
4. Indicate contractor's name, address, and telephone number. Include name and telephone number of the 24-hour contact person representing the contractor.
5. Indicate north arrow and scale, unless otherwise approved by the Department of Public Works.
6. Show all nearby streets with street names to assure proper orientation.

Land Development

Traffic Control Plan Guidelines & Checklist

41000 Main Street
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7. Show existing traffic signals and regulatory signs within the work area and affected construction zone.
8. Show existing striping, pavement markings, painted crosswalks, and bike lanes area within the work area and affected construction zone.
9. Show existing curbs, gutters, sidewalks, driveways and intersections in the construction work zone including areas affected by taper transition.
10. **Dimension** all existing striping and proposed traffic control area within the work area and affected construction zone. Indicate total roadway widths. Dimension existing striping from edges of pavement.
11. Indicate posted speed limits.
12. Show location and dimensions of the construction work zone (width and length).
13. Show staging area and materials storage area, as appropriate.
14. Indicate location of construction signs, barricades, and delineators.
15. Label all taper lengths and widths, delineator spacing and sign spacing. (Spacing of channelizing devices should not exceed 25' for speeds under 55 MPH.)
16. Use a legend to define all signs and symbols and designate them with MUTCD nomenclature.
17. Show existing and proposed temporary parking restriction zones and signs, as needed, within the work area.
18. Road closures will require approval from the Director of Public Works and the City Council.
19. Signs and barricades will be required to direct **pedestrians** through or around the construction work zone and shall be shown on the TCP.
20. Indicate the encroachment permit number or improvement plan number on the traffic control plan.
21. Indicate on the plan the duration of the construction work and subsequent traffic control (include type of work being performed and estimated start date, as appropriate).
22. Detour plan (if required).
23. Please reference the revision date of the "TRAFFIC CONTROL PLAN GUIDELINES" document to ensure that you are using the latest edition.