C I T Y OF B U R L I N G A M E

DEPARTMENT OF PUBLIC WORKS

NOTICE TO BIDDERS

INSTRUCTION TO BIDDERS

PROPOSAL AND AGREEMENT

SPECIAL PROVISIONS

FOR

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

FOR USE IN CONNECTION WITH
STANDARD SPECIFICATIONS DATED 2010
AND STANDARD PLANS DATED 2010
OF THE CALIFORNIA DEPARTMENT OF TRANSPORTATION

MAYOR:	MICHAEL BROWNRIGG , MAYOR
CITY COUNCIL:	DONNA COLSON, VICE MAYOR EMILY BEACH ANN KEIGHRAN RICARDO ORTIZ
CITY MANAGER:	LISA GOLDMAN
CITY CLERK:	MEAGHAN HASSEL-SHEARER

KEVIN OKADA, P.E.
SR. CIVIL ENGINEER
RCE 65014
EXP. 6-30-19

BIDS WILL BE OPENED AT 2:00 P.M. ON OCTOBER 30, 2018 IN
CONFERENCE ROOM "B" OF THE BURLINGAME CITY HALL

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INDEX

TECHNICAL SPECIFICATIONS

DIVISION 27 – Communications
27 05 28 Pathways for Communications Systems
27 05 44 Sleeves and Sleeves Seals for Communications Pathway and Cabling
27 15 00 Horizontal Communications Cabling

DIVISION 28 – FIRE DETECTION ALARM
28 31 00 Fire Detection and Alarm System

DIVISION 31 – EARTHWORK
31 23 33 Trenching and Backfill

DIVISION 32 – EXTERIOR IMPROVEMENTS
32 11 23 Aggregate Base
32 13 13 Concrete Paving

……..
City Standard details are available upon request or found on the City webpage at:
http://www.burlingame.org/index.aspx?page=161
Burlingame.org/departments/engineering/city standard details.

*** END OF SECTION ***

The City of Burlingame

PUBLIC WORKS DEPARTMENT
(650) 558-7230

CITY HALL - 501 PRIMROSE ROAD
BURLINGAME, CALIFORNIA 94010-3997

CORPORATION YARD
(650) 558-7670

NOTICE TO BIDDERS

For the **CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS, CITY PROJECT NO. 84340,** sealed proposals will be received at the office of the City Clerk, City Hall, 501 Primrose Road, Burlingame, California, until 2:00 P.M., on Tuesday, October 30, 2018. Sealed bids will be publicly opened and read at 2:00 P.M. on that date in City Hall Conference Room "B", in the City of Burlingame, San Mateo County, California.

Plans and Specifications covering the work may be obtained by prospective bidders upon application and a cash, check, or credit card non-refundable fee of $90.00, or $95.00 if contract documents are mailed (USPS only), at Public Works Engineering, 501 Primrose Road, Burlingame, CA 94010.

The City of Burlingame intends to make improvements on the existing Central County Fire Department Station 35 including renovations of the station sleeping quarters, replacement mechanical systems, hot water heaters, and electrical panel. The station will have fire alarm and sprinkler system designed for the entire station but installed only in the sleeping quarters. Repainting and reroofing of the station is by alternate price.

Special Provisions, Specifications and Plans, including prevailing wage rates to be paid in compliance with Section 1773.2 of the California Labor Code and related provisions, may be inspected in the office of the City Engineer during normal working hours at City Hall, 501 Primrose Road, Burlingame, California, and are also available for review at the State of California Department of Industrial Relations' Web site.

A non-mandatory pre-bid meeting associated with this project will be held on Tuesday October 23, at 10AM, at City Hall, 501 Primrose Road – Conference Room B, Burlingame, California.

The Contractor shall possess a Class B license prior to submitting a bid.

No contractors and subcontractor may be listed on the bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.5(a)].

All contractors and subcontractors will be required to furnish electronic certified payroll records directly to the Labor Commissioner (aka Division of Labor Standards Enforcement).

All work specified in this project, shall include the base bid and alternate bids (if shown in Proposal), and shall be completed within **180 of Working Days (WD) (one hundred eighty working days)** from date of the Notice to Proceed.

Kevin Okada, P.E.
Senior Civil Engineer

DATE OF POSTING: 10/9/18

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INSTRUCTIONS TO BIDDERS

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

Proposals shall be submitted in accordance with the Special Provisions and these Instructions.

General Instructions

A. Bids shall be made upon the form provided, properly executed and with all items completed. All signatures shall be in longhand.

B. Bids shall not be unbalanced. Any apparent unbalancing of bids may be considered sufficient grounds for rejection of a proposal.

C. A proposal shall cover all items of the bidding schedule. Blank spaces in the bid shall be properly filled in, and the wording thereof must not be changed. Additions shall not be made to the items mentioned therein. Any unauthorized conditions, limitations or provisions attached to a proposal may cause its rejection. Alterations by erasures or interlineation shall be explained or noted in the bid over the signature of the bidder.

D. Late bids will be returned to the bidder unopened.

E. Each bid shall be addressed to the City Clerk of the City of Burlingame, and shall be delivered to the office of the City Clerk of the City of Burlingame, 501 Primrose Road, Burlingame, California 94010, on or before the day and time set for the opening of bids. The bid shall be enclosed in a sealed envelope bearing the title of the project, the name of the bidder, and the date and time of the opening. It is the sole responsibility of the bidder to ensure that the bid is received in proper time at the office of the City Clerk.

F. Cash deposits for Plans and Specifications will not be refunded.

Licensure

All bidders shall have the class of license(s) listed in the Notice Inviting Sealed Bids prior to submitting a bid.

Bidder's Bond

Each bid must be accompanied by cash, a certified or cashier's check, or a bidder's bond in the sum of not less than ten percent (10%) of the total aggregate of the bid, and such a check or bond shall be made payable to the City of Burlingame as set forth in Section 3 of the Special Provisions. If the successful bidder fails to file the bonds or to provide the insurance required by the Contract Documents, or refuses to enter into a contract within the specified time, it shall be liable for any difference by which the cost of procuring the work exceeds the amount of its bid and the bond or the amount of cash or check shall be available to offset such difference.

Examination of Plans, Specifications and Site Work

Before submitting a bid, each bidder shall carefully read the Specifications and all other Contract Documents. The bidder shall visit the site of the Project and shall fully inform itself as to all existing conditions and limitations under which the work is to be performed, and it shall include in its bid a sum to cover the cost of all items necessary to perform the work as set forth in the Contract Documents. No allowance of any kind whatsoever will be made to any bidder because of lack of such examination or knowledge. The submission of a bid shall be conclusive evidence that the bidder has made such an examination. *Bidders shall report any discrepancies in the field conditions or Contract Documents that they discover to the City before bids are opened.*

Competency of Bidder

Any bidder may be required to furnish evidence satisfactory to City that it and its proposed subcontractors have sufficient means and experience in the type of work called for to insure completion of the contract in a satisfactory manner.

Withdrawal of Bid

Any bidder may withdraw its bid, either personally or by a written request, at any time prior to the scheduled time for opening of bids.

Award or Rejection of Bids

The Contract, if awarded, will be awarded to the lowest responsible bidder subject to City's right to reject any or all bids and to waive informalities to the fullest extent provided by law in the bids.

Withdrawal of Bids after Opening

No bidder may withdraw its bid for a period of sixty (60) calendar days after the date set for the opening thereof, and the same shall be subject to acceptance by the City during this period.

Execution of Agreement

The successful bidder, as Contractor shall, within ten (10) calendar days after notice of award, execute and deliver to City one original and one counterpart of the Agreement, which is included in the Contract Documents.

Performance Bond, Labor and Materialpersons Bond, Deposit of Securities

At or prior to the delivery of the signed Agreement, Contractor shall deliver to the City a Faithful Performance Bond and a Contractor's Payment (Labor and Materials) Surety Bond, as are required by the Special Provisions. All bonds shall be in the general forms designated by City, and each shall be in an amount equal to one hundred percent (100%) of the contract price. All bonds shall be approved by the City Attorney before the successful bidder may proceed with the work. Failure or refusal to furnish bonds in the form satisfactory to the City Attorney shall subject the bidder to penalties for delay in commencement of the work or revocation of the award of contract.

Pursuant to Section 22300 of the California Public Contract Code, the Contractor will be permitted, at its request and sole expense, to substitute securities for any monies withheld by the City, as provided in the Special Provisions.

Insurance

At or prior to the delivery of the signed Contract Agreement, Contractor shall deliver to the City the policies of insurance and certificates and endorsements that are required by the Special Provisions. Failure or refusal to furnish insurance policies or certificates in the form satisfactory to the City Attorney shall subject the bidder to penalties for delay in commencement of the work or revocation of the Award of Contract. All policies,

endorsements, and certificates of insurance shall be approved by the City Attorney before the successful bidder may proceed with any work.

Interpretation of Drawings and Documents Prior to Bidding

If any potential bidder is in doubt as to the true meaning of any part of the Plans, Specifications, or other Contract Documents, or finds discrepancies in, or omissions from the Plans or Specifications, it may submit to the City Engineer a written request for an interpretation or correction thereof not later than five working days before the date bids will be opened. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the Contract Documents will be made only by addendum. Bidders shall confirm the existence of any and all addenda. The City will not be responsible for any other explanation or interpretation of the Contract Documents.

Addenda

Addenda issued during the time of bidding shall become a part of the documents furnished to bidders for the preparation of bids, shall be covered in the bids and shall be made a part of the Contract Documents. Each bid shall include specific acknowledgement in the space provided of receipt of all Addenda issued during the bidding period. Failure to do so may result in the bid being rejected and labeled as nonresponsive. Failure of any bidder to receive such Addenda shall not be grounds for non-compliance with the terms of the instructions. It is the responsibility of the Contractor to contact the City to determine the existence of any and all addenda.

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 for the same work, unless alternate bids are called for. A person, firm or corporation submitting a sub-proposal to a bidder, or who has quoted prices on materials to a bidder, is not thereby disqualified from submitting a sub-proposal or quoting prices to other bidders.

Special Notice

Bidders are required to inform themselves fully of the conditions relating to construction and labor under which the work will be or is now performed, and, so far as possible, the successful bidder must employ such methods and means in carrying out his/her work as will not cause any interruption or interference with any other Contractor.

List of Subcontractors

Bidders shall submit a list of their proposed subcontractors in compliance with Sections 4100-4113 of the Public Contract Code of the State of California. A form for this designation is furnished in the Contract Documents.

Additional Sureties

If at any time during the continuance of the contract the Sureties, or any of them, shall, in the opinion of City, be no longer responsible, the City shall have the right to require additional and sufficient Sureties which Contractor shall furnish to the satisfaction of City within ten (10) working days after notice.

Definition of Contract Documents

The term "Contract Documents" is defined in section 1.03 Definitions and Terms of the Special Provisions and in the AGREEMENT FOR PUBLIC IMPROVEMENT. The submission of any bid shall be deemed a thorough and complete understanding of all provisions of the Contract Documents.

Business License

All Contractors, whether they are general Contractors or subcontractors, who transact or carry on business in the City, shall acquire a Business License in conformance with the Burlingame Municipal Code.

Wages

Workers employed in the work must be paid at rates at least equal to the then current prevailing wage scale as determined by the State Director of the Department of Industrial Relations. A copy is on file in the City Department of Public Works, and is also available for review at the State of California Department of Industrial Relations' web site at www.dir.ca.gov/DLSR/PWD.

Pursuant to Labor Code Section 1770 *et. seq*, any Contractor who is awarded a public works project and intends to use a craft or classification not shown on the general prevailing wage determinations, may be required to pay the wage rate of that craft or classification most closely related to it as shown in the general determinations effective at the time of the calls for bids.

Unit Prices

Because unit prices are key elements of bid award and contract administration, in case of discrepancy between the unit price and the total set for a unit basis item, the unit price shall prevail. If, however, the unit price is omitted, ambiguous, unintelligible, or uncertain for any reason, or if it is the same amount as set forth in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail and shall be divided by the estimated quantity to determine the unit price.

*** END OF SECTION ***

GENERAL

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

_____ ____, 20___

TO THE CITY OF BURLINGAME, CALIFORNIA:

Pursuant to the foregoing Notice to Contractors, the undersigned bidder herewith submits its proposal on the Bid Form, Designation of Subcontractors, and Statement of Experience Qualifications, Non-Collusion Declaration, and Statement under Public Contract Code Section 10285.1 attached hereto and made a part hereof, and binds itself on award by the City of Burlingame under this proposal to execute in accordance with such award, a contract, of which this Proposal and the Notice to Contractors, Instructions to Bidders, Special Provisions, Standard Specifications, and Plans and Specifications are hereby made a part of this Proposal and all provisions thereof are hereby accepted.

In submitting this proposal, the bidder has confirmed the existence of any and all addenda and accepts the changes to the contract included in all addenda.

The bidder further agrees that in case of its default in executing the Contract Documents, and providing the required bonds and insurance, the cash, check or Bidder's Bond, accompanying its proposal and the money payable thereon shall be and remain the property of the City of Burlingame, as provided in the Instructions to Bidders and the Special Provisions.

Company name: _____

_____
(Corporate Seal)

Signature _____

Address _____

Contractor’s license number: _____

Contractor’s telephone no. _____

Contractor’s facsimile no. _____

If a corporation, organized under the laws of the state of: _____,

Nature of firm (corporation, partnership, etc.) and names of individual members of the firms, or names and titles of officers of the corporation:

Name _____ Title _____

Name _____ Title _____

Name _____ Title _____

Name _____ Title _____

DESIGNATION OF SUBCONTRACTORS

(Public Contract Code Sections 4100 *et seq.*)
TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID PROPOSAL
CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

As a bidder on the above-entitled project, the undersigned hereby designates the subcontractors that will perform work or labor or render services to the Contractor in or about the construction of the project in an amount in excess of one-half (1/2) of one percent (1%) of the Contractor's total bid or $10,000 whichever is greater.

The undersigned understands and agrees that should it fail to specify a subcontractor for any portion of the work as above stated, it agrees that the undersigned is fully qualified to perform that portion of the work itself, and that it shall perform that portion itself. Penalties for failure to comply with this provision are provided in the Subletting and Subcontracting Fair Practices Act commencing with Section 4100 of the Public Contract Code.

Pursuant to Public Contract Code Section 6109, Contractor shall not allow or permit any subcontractor that is ineligible to perform work on a public works project pursuant to Labor Code Section 1777.1 or 1777.7, to perform any work on this Project.

The undersigned agrees that it shall not, without written consent of the City Council, make any substitution, assignment or sublet to or of the following list of subcontractors which is made a part of this proposal and then only after compliance with the provisions of the Subletting and Subcontracting Fair Practices Act. [ATTACH ADDITIONAL PAGES IF NECESSARY]

LIST OF SUBCONTRACTORS

NAME OF SUBCONTRACTOR	ADDRESS OF SUBCONTRACTOR	STATE CONTRACTORS LICENSE #	DIR REGISTRATION #	WORK TO BE DONE BY SUBCONTRACTOR

NAME OF BIDDER: _____

Signature: _____

STATEMENT OF EXPERIENCE QUALIFICATIONS

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID PROPOSAL
CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

The following statement as to experience qualifications of the bidder is submitted in conjunction with the Proposal, as a part thereof, and the truthfulness and accuracy of the information is guaranteed by the Bidder.

The bidder has been engaged in the contracting business, under the present business name, for years. Experience in work of a nature similar to that covered in the proposal extends over a period of _____ years.

The bidder, as a contractor, has never failed to satisfactorily complete a contract awarded to it, except as follows:

_____

_____

The following contracts have been satisfactorily completed in the last three years for the persons, firm or authority indicated, and to whom reference is made:

YEAR	TYPE OF WORK PROJECT NAME	CONTRACT AMOUNT	LOCATION	FOR WHOM PERFORMED	CONTACT NAME AND PHONE NO.

The following is a list of plant and equipment owned by the bidder, which is definitely available for use on the proposed work as required:

QUANTITY	NAME, TYPE, CAPACITY	CONDITION	LOCATION

NAME OF BIDDER: _____

Signature: _____

NON-COLLUSION DECLARATION

(PUBLIC CONTRACT CODE SECTION 7106)
TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID PROPOSAL
CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

I, _____, declare under penalty of perjury that I am (sole owner, partner, president, etc.) 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 or 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.

I declare under penalty of perjury that the foregoing is true and correct and this was executed on the date shown below at _____.
(City, State)

Dated: _____

NAME OF BIDDER: _____

Signature _____

PUBLIC CONTRACT CODE SECTION 10285.1 STATEMENT

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID
CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

In accordance with Public Contract Code Section 10285.1 (Stats. 1985, Ch. 376), the bidder hereby declares under penalty of perjury under the laws of the State of California that the bidder has_____, has not _____ been convicted within the preceding three years of any offenses referred to in that section, including any charge of fraud, bribery, collusion, conspiracy, or any other act in violation of any state or federal antitrust law in connection with the bidding upon, award of, or performance of, any public works contract, as defined in Public Contract Code Section 1101, with any public entity, as defined in Public Contract Code Section 1100, including the Regents of the University of California or the Trustees of the California State University. The term "bidder" is understood to include any partner, member, officer, director, responsible managing officer, or responsible managing employee thereof, as referred to in Section 10285.1.

[NOTE: THE BIDDER MUST PLACE A CHECK MARK AFTER "HAS" OR "HAS NOT" IN ONE OF THE BLANK SPACES ABOVE.]

The above Statement is part of the Proposal. Bidders are warned that making a false certification may subject the certifier to criminal prosecution.

I declare under penalty of perjury that the foregoing is true and correct and this was executed on the date shown below at _____.
(City, State)

Dated: _____

NAME OF BIDDER: _____

Signature _____

PUBLIC CONTRACT CODE SECTION 10162 QUESTIONNAIRE

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID PROPOSAL

In accordance with Public Contract Code Section 10162, the Bidder shall complete, under penalty of perjury, the following questionnaire:

Has the bidder, any officer of the bidder, or any employee of the bidder who has a proprietary interest in the bidder, ever been disqualified, removed, or otherwise prevented from bidding on, or completing a federal, state, or local government project because of a violation of law or a safety regulation?

No_____ Yes_____

If the answer is yes, explain the circumstances below:

I declare under penalty of perjury that the foregoing is true and correct and this was executed on the date shown below at _____.
(City, State)

Dated: _____

NAME OF BIDDER: _____

Signature _____

Public Contract Code 10232 Statement

In accordance with Public Contract Code Section 10232, the Contractor, hereby states under penalty of perjury, that no more than one final unappealable finding of contempt of court by a federal court has been issued against the Contractor within the immediately preceding two year period because of the Contractor's failure to comply with an order of a federal court which orders the Contractor to comply with an order of the National Labor Relations Board.

Note: The above Statement and Questionnaire are part of the Proposal. Signing this Proposal on the signature portion thereof shall also constitute signature of this Statement and Questionnaire. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

I declare under penalty of perjury that the foregoing is true and correct and this was executed on the date shown below at _____.
(City, State)

Dated: _____

NAME OF BIDDER: _____

Signature _____

BID SHEET

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

BID SCHEDULE:

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE $	ITEM TOTAL
1	General Conditions (I.e. Project Management, Field Supervision, Mobilization Traffic Control, Temp Utilities, Permit Fees, Toilets/Wash Station(s), Misc. Hand Tools, Misc. Equipment, any other project site related costs not included in items 2 - 4 below)	LS	LS		
2	Site Demolition & Site work (Division 3, 31, and 32)	LS	LS		
3	MEP (Divisions 21, 22, 23, 26, 27 and 28)	LS	LS		
4	Building (all Divisions not noted above)	LS	LS		
5	Contractor Overhead and Profit	LS	LS		
6	Bonding	LS	LS		
7	Insurance	LS	LS		
Base Bid					
The lowest responsive and responsible bidder will be determined on the basis of the lowest Base Bid amount. Total Base Bid includes Items 1-7, all work shown in Plans and Specifications, AND EXCLUDING Bid Alternates 1 to 6					
BA-1	Roofing & Skylights	LS	LS		
BA-2	Windows and Patio Door for Living Spaces & Apparatus Bay	LS	LS		
BA-3	Fire Protection System	LS	LS		
BA-4	East Water Heater	LS	LS		
BA-5	Basement HVAC	LS	LS		
BA-6	Paint Interior walls, ceiling, and trim of rooms Apparatus Bay and Utility	LS	LS		

1. A proposal must include a total estimated amount together with an estimated amount for each item listed herein. Failure to do so may cause the proposal to be considered nonresponsive.
2. All quantities are estimated except where the unit is given as "LS".
3. Job prices shall cover all work complete and finished in accordance with the Contract Documents.
4. Reference Bid Specification Manual for CSI Division breakdowns
5. City reserves the right to either include or exclude bid alternates BA1-BA6 from the authorized construction scope of work depending on the City's available funds and bid amount.

BIDDING CONTRACTOR'S SIGNATURE: _____

BIDDING CONTRACTOR'S NAME: _____

_____ _____
CONTRACTOR'S LICENSE NUMBER EXPIRATION DATE

_____
CONTRACTOR'S ADDRESS

_____
CONTRACTOR'S TELEPHONE NO.

_____
DATE

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AGREEMENT FOR PUBLIC IMPROVEMENT

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS

CITY PROJECT NO. 84340

THIS AGREEMENT, made in duplicate and entered into in the City of Burlingame, County of San Mateo, State of California on _____, 2018 by and between the CITY OF BURLINGAME, a Municipal Corporation, hereinafter called "City", and _____, a [State of incorporation] [Corporation or other form of business], hereinafter called "Contractor."

WITNESSETH:

WHEREAS, City has taken appropriate proceedings to authorize construction of the public work and improvements herein provided for and to authorize execution of this Contract; and

WHEREAS, pursuant to State law and City requirements, a notice was duly published for bids for the contract for the improvement hereinafter described; and

WHEREAS, on _____, after notice duly given, the City Council of Burlingame awarded the contract for the construction of the improvements hereinafter described to Contractor, which the Council found to be the lowest responsive, responsible bidder for these improvements; and

WHEREAS, City and Contractor desire to enter into this Agreement for the construction of said improvements.

NOW, THEREFORE, IT IS AGREED by the parties hereto as follows:

1. Scope of work.

Contractor shall perform the work described in those Contract Documents entitled: CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS, CITY PROJECT NO. 84340.

2. The Contract Documents.

The complete contract between City and Contractor consists of the following documents: this Agreement; Notice Inviting Sealed Bids, attached hereto as Exhibit A; the accepted Bid Proposal, attached hereto as Exhibit B; the specifications, provisions,

addenda, complete plans, profiles, and detailed drawings contained in the bid documents titled “CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS, City Project No. 84340” attached as Exhibit C; the State of California Standard Specifications 2010, as promulgated by the California Department of Transportation; prevailing wage rates of the State of California applicable to this project by State law; and all bonds; which are collectively hereinafter referred to as the Contract Documents. All rights and obligations of City and Contractor are fully set forth and described in the Contract Documents, which are hereby incorporated as if fully set forth herein. All of the above described documents are intended to cooperate so that any work called for in one, and not mentioned in the other, or vice versa, is to be executed the same as if mentioned in all said documents.

3. Contract Price.

The City shall pay, and the Contractor shall accept, in full, payment of the work above agreed to be done, the sum of _____ dollars ($_____), called the “Contract Price”. This price is determined by the lump sum and unit prices contained in Contractor's Bid. In the event authorized work is performed or materials furnished in addition to those set forth in Contractor's Bid and the Specifications, such work and materials will be paid for at the unit prices therein contained. Said amount shall be paid in progress payments as provided in the Contract Documents.

4. Termination

At any time and with or without cause, the City may suspend the work or any portion of the work for a period of not more than 90 consecutive calendar days by notice in writing to Contractor that will fix the date on which work will be resumed. Contractor will be granted an adjustment to the Contract Price or an extension of the Time for Completion, or both, directly attributable to any such suspension if Contractor makes a claim therefor was provided in the Contract Documents.

The occurrence of any one or more of the following events will justify termination of the contract by the City for cause: (1) Contractor’s persistent failure to perform the work in accordance with the Contract Documents; (2) Contractor’s disregard of Laws or Regulations of any public body having jurisdiction; (3) Contractor’s disregard of the authority of the Engineer; or (4) Contractor’s violation in any substantial way of any provision of the Contract Documents. In the case of any one or more of these events,

the City, after giving Contractor and Contractor's sureties seven calendar days written notice of the intent to terminate Contractor's services, may initiate termination procedures under the provisions of the Performance Bond. Such termination will not affect any rights or remedies of City against Contractor then existing or that accrue thereafter. Any retention or payment of moneys due Contractor will not release Contractor from liability. At the City's sole discretion, Contractor's services may not be terminated if Contractor begins, within seven calendar days of receipt of such notice of intent to terminate, to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 calendar days of such notice.

Upon seven calendar days written notice to Contractor, City may, without cause and without prejudice to any other right or remedy of City, terminate the Contract for City's convenience. In such case, Contractor will be paid for (1) work satisfactorily completed prior the effective date of such termination, (2) furnishing of labor, equipment, and materials in accordance with the Contract Documents in connection with uncompleted work, (3) reasonable expenses directly attributable to termination, and (4) fair and reasonable compensation for associated overhead and profit. No payment will be made on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

5. Provisions Cumulative.

The provisions of this Agreement are cumulative and in addition to and not in limitation of any other rights or remedies available to the City.

6. Notices.

All notices shall be in writing and delivered in person or transmitted by certified mail, postage prepaid.

Notices required to be given to the City shall be addressed as follows:

Mr. Kevin Okada
Senior Engineer
City of Burlingame
501 Primrose Road
Burlingame, California 94010

Notices required to be given to Contractor shall be addressed as follows:

Name
Company Name

Address

7. Interpretation

As used herein, any gender includes the other gender and the singular includes the plural and vice versa.

8. Waiver or Amendment.

No modification, waiver, mutual termination, or amendment of this Agreement is effective unless made in writing and signed by the City and the Contractor. One or more waivers of any term, condition, or other provision of this Agreement by either party shall not be construed as a waiver of a subsequent breach of the same or any other provision.

9. Controlling Law.

This Agreement is to be governed by and interpreted in accordance with the laws of the State of California.

10. Successors and Assignees.

This Agreement is to be binding on the heirs, successors, and assigns of the parties hereto but may not be assigned by either party without first obtaining the written consent of the other party.

11. Severability.

If any term or provision of this Agreement is deemed invalid, void, or unenforceable by any court of lawful jurisdiction, the remaining terms and provisions of the Agreement shall not be affected thereby and shall remain in full force and effect.

12. Indemnification.

Contractor shall indemnify, defend, and hold the City, its directors, officers, employees, agents, and volunteers harmless from and against any and all liability, claims, suits, actions, damages, and causes of action arising out of, pertaining or relating to the actual or alleged negligence, recklessness or willful misconduct of Contractor, its employees, subcontractors, or agents, or on account of the performance or character of the services, except for any such claim arising out of the sole negligence or willful misconduct of the City, its officers, employees, agents, or volunteers. It is

understood that the duty of Contractor to indemnify and hold harmless includes the duty to defend as set forth in section 2778 of the California Civil Code. Notwithstanding the foregoing, for any design professional services, the duty to defend and indemnify City shall be limited to that allowed by state law. Acceptance of insurance certificates and endorsements required under this Agreement does not relieve Contractor from liability under this indemnification and hold harmless clause. This indemnification and hold harmless clause shall apply whether or not such insurance policies shall have been determined to be applicable to any of such damages or claims for damages.

IN WITNESS WHEREOF, two identical counterparts of this Agreement, consisting of five pages, including this page, each of which counterparts shall for all purposes be deemed an original of this Agreement, have been duly executed by the parties hereinabove named on the day and year first hereinabove written.

CITY OF BURLINGAME,
a Municipal Corporation

By _____
Lisa K. Goldman, City Manager

Approved as to form:

_____
Kathleen Kane, City Attorney

"CONTRACTOR"

By _____
Print Name:
Company Name:

ATTEST:

_____
Meaghan Hassel-Shearer, City Clerk

CITY OF BURLINGAME

DEPARTMENT OF PUBLIC WORKS

SPECIAL PROVISIONS

FOR

CENTRAL COUNTY FIRE DEPARTMENT STATION 35 IMPROVEMENTS
CITY PROJECT NO. 84340

GENERAL CONDITIONS

SECTION 1. DEFINITIONS AND TERMS

1.01 General

The following shall be added to Standard Specifications Section 1-1.01:

The work contemplated herein shall be done in accordance with these Specifications as defined in the Special Provisions Section 1.03, and the Municipal Code of the City of Burlingame, insofar as the same may apply and in accordance with the following Special Provisions.

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

1.02 Abbreviations

Abbreviations of the Standard Specifications shall be amended to include the following:

AIA	American Institute of Architects
APWA	American Public Works Association
ASA	American Standard Association
CSI	Construction Specifications Institute
IAMPO	International Association of Mechanical & Plumbing Officials
ICBO	International Conference of Building Officials
UBC	Uniform Building Code
UPC	Uniform Plumbing Code

1.03 Definitions and Terms

The definitions in Standard Specifications Section 1-1.07B are amended as follows:

As used herein, unless the context otherwise requires, the following terms have the following meanings:

Agency: The legal entity for which the work is being performed.

Authorized Laboratory: The laboratory authorized by the Engineer to test materials and work involved in the contract.

Contract Documents: The Contract Documents shall include the complete contract between City and Contractor, which shall consist of the following documents: the Agreement and Notice Inviting Sealed Bids; the accepted Bid Proposal; the specifications, provisions, addenda, complete plans, profiles, and detailed drawings contained in the bid documents entitled "South Rollins Road Utility Improvements – Phase 1, City Project No. 83520"; the State of California Standard Specifications 2010, as promulgated by the California Department of Transportation; prevailing wage rates of the State of California applicable to this project by State law; and all bonds. All rights and obligations of City and Contractor are fully set forth and described in the Contract Documents, which are hereby incorporated as if fully set forth herein. All of the above described documents are intended to cooperate so that any work called for in one, and not mentioned in the other, or vice versa, is to be executed the same as if mentioned in all said documents. In case of any inconsistencies among the various documents, the Agreement shall prevail.

Contract Acceptance: The formal written contract acceptance of an entire contract by the City Council at a regularly scheduled meeting, recorded in the County of San Mateo Recorder's Office, titled "Notice of Completion," signed by an authorized official of the City of Burlingame, which has been completed in all respects in accordance with the plans and specifications and any modification thereof previously approved.

City: The City of Burlingame, State of California.

Department: The Department of Public Works of the City of Burlingame.

Director: The Director of Public Works of the City of Burlingame, California.

Engineer: The City Engineer of the City of Burlingame, State of California, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

Inspector: An inspector employed or retained by the City to perform inspection during construction of the work under the direction of the Director.

Legal Holiday: A holiday as specified in Section 5.04 of these Special Provisions.

Owner: The City of Burlingame, a political subdivision of the State of California.

Plans: Standard plans, revised standard plans and project plans.

1. **Project plans**: Drawings specific to the project, including authorized shop drawings.
2. **Standard plans:** *2010 California Department of Transportation Standard Plans, City of Burlingame Standard Details*, and any other local agency or district standard plans or details referenced in project plans.

The California Department of Transportation standard plans are available at:
http://www.dot.ca.gov/hq/esc/oe/construction_standards.html

The City of Burlingame Standard Details are available at:
http://www.burlingame.org/index.aspx?page=161
Burlingame.org/departments/engineering/city standard details.

Specifications: Standard specifications, and special provisions, as follows:

1. **Special Provisions:** Specifications specific to the project. These specifications are in a section titled *Special Provisions* of this bid book titled *Notice to Bidders/Proposal and Agreement/Special Provisions*.

2**. Standard Specifications:** Specifications standard to City construction projects. These specifications are in a book titled State of California Department of Transportation *Standard Specifications 2010* (Standard Specifications or SS). These standard specifications are available at:
http://www.dot.ca.gov/hq/esc/oe/construction_standards.html

Any reference therein to the State of California or a State agency, office or officer, acting under the Standard Specifications shall be interpreted to refer to the City or its corresponding agency, office or officer acting under this contract.

State: In references where context applies to "State" as the owner of the Project, the City of Burlingame.

Supplementary General Conditions: The part of the Contract Documents that makes additions, deletions, or revisions to these General Conditions.

Technical Specifications: Those portions of the Contract Documents consisting of the written technical descriptions of products and execution of the Work.

Work: The entire completed construction required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

*** END OF SECTION ***

SECTION 2. BIDDING

2.01 General

The bidder's attention is directed to the provisions in Section 2, "Bidding," of the Standard Specifications and these Special Provisions for the requirements and conditions which it shall observe in the preparation of the proposal form and the submission of the bid.

The following Sections in the Standard Specifications are deleted:

2-1.15, "Disabled Veterans Business Enterprises".
2-1.18, "Small Business and Non-small Business Subcontracting Preferences".
2-1.27, "California Companies"

2.02 Subcontractor List

Standard Specifications Section 2-1.10, “Subcontractor List,” is replaced by the following:

2-1.10 SUBCONTRACTOR LIST

On the Subcontractor List form, list each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or $10,000, whichever is greater (Pub Cont Code § 4100 et seq.).

For each subcontractor listed, the Subcontractor List form must show:

1. Business name and the location of its place of business.
2. California contractor license number for a non-federal-aid contract.
3. Public works contractor registration number
4. Portion of work it will perform.

2.03 Proposal Pages

Standard Specifications Section 2-1.33, “Bid Document Completion” is amended to provide that the bid documents shall include the required proposal pages or copies thereof completed and signed, including Proposal to the City of Burlingame, Designation of Subcontractors, Experience Qualifications, Non-Collusion Declaration, Public Contract Code Compliance Statement and Questionnaire, and Bid Sheet in these Special Provisions.

2.04 Compliance Statement

The Contractor shall complete a statement indicating compliance with Public Works Contracts Code Section 10285.1 and Public Contract Code Section 10162 Questionnaire. These documents shall be completed and included in the Proposal.

2.05 Bidder's Security

Standard Specifications Section 2-1.34, “Bidder’s Security” is replaced with the following:

If Contractor’s bid is greater than $25,000, a Contractor shall submit bid with one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cashier's check
2. Certified check
3. Signed bidder’s bond by an admitted surety insurer

A sample bid bond is provided at the end of this Section.

Bidders shall submit a cashier’s check, a certified check, or a bidder’s bond to the City before the bid opening time. The bidder's security shall be made payable to the City of Burlingame.

*** END OF SECTION ***

BIDDER'S BOND

KNOW ALL PERSONS BY THESE PRESENTS:

That we, as Principal, and _____ _____ as Surety, are held and firmly bound unto the City of Burlingame, a municipal corporation of the State of California (hereinafter called "City") in the penal sum of ten percent (10%) of the total aggregate amount of the bid of the Principal above named, submitted by said Principal to the City for the work described below, for the payment of which sum in lawful money of the United State, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents. In no case shall the liability of the Surety hereunder exceed the sum of _____($_____) Dollars.

The condition of this obligation is such that a bid to the City for certain construction specifically described as follows, for which bids are to be opened on _____, _____, 20___, at ___:_____, has been submitted by Principal to City:

NOW THEREFORE, if the Principal is awarded the Contract and within the time and manner required under the Specifications, after the prescribed forms are presented to the Principal for signature, enters into a written contract, in the prescribed form, in accordance with the bid, and files two bonds with the City, one to guarantee faithful performance of the Contract and the other to guarantee payment for labor and materials as provided by law as well as files insurance certificates and equal employment opportunity documentation required under the bid, then this obligation shall be null and void; otherwise, it shall remain in full force.

In the event suit is brought upon said bond by City, and judgment is recovered, the Surety shall pay all costs incurred by City in such suit, including a reasonable attorney's fee to be fixed by the Court.

IN WITNESS WHEREOF, we have hereunto set our hands and seals on this day of _____, 20 ____.

_____(Seal)

_____(Seal)

_____(Seal)

_____(Seal)

_____(Seal)

_____

_____

NOTE: Attach notary acknowledgment for signatures of those executing for Principal and Surety

SECTION 3. AWARD AND EXECUTION OF CONTRACT

3.01 General

The bidder's attention is directed to the provisions of Standard Specifications Section 2, "Bidding," and Section 3 "Contract Award and Execution," , and to "Proposal Requirements and Conditions," of these Special Provisions for the requirements and conditions concerning award and execution of the contract, with the following clarifications, changes and additions.

The second paragraph of Standard Specifications Section 3-1.02A, “General,” is replaced with the following:

In the case of unit basis items, the amount set forth under the "Item Total" column shall be the product of the unit price bid and the estimated quantity for the item.
In case of discrepancy between the unit price and the total set forth for a unit basis item, the unit price shall prevail, except as provided in (a) or (b), as follows:

(a) If the amount set forth as a unit price is unreadable or otherwise unclear, or is omitted, or is the same as the amount as the entry in the item total column, then the amount set forth in the item total column for the item shall prevail and shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price;

(b) (Decimal Errors) If the product of the entered unit price and the estimated quantity is exactly off by a factor of ten, one hundred, etc., or one-tenth, or one-hundredth, etc. from the entered total, the discrepancy will be resolved by using the entered unit price or item total, whichever most closely approximates percentagewise the unit price or item total in the Agency's Engineer Estimate of cost.

If both the unit price and the item total are unreadable or otherwise unclear, or are omitted, the bid may be deemed irregular. Likewise if the item total for a lump sum item is unreadable or otherwise unclear, or is omitted, the bid may be deemed irregular unless the project being bid has only a single item and a clear, readable total bid is provided.

Symbols such as commas and dollar signs will be ignored and have no mathematical significance in establishing any unit price or item total or lump sums. Cents symbols also have no significance in establishing any unit price or item total because all figures are assumed to be expressed in dollars and/or decimal fractions of a dollar. Written unit prices, item totals and lump sums will be interpreted according to the number of digits and, if applicable, decimal placement. Bids on lump sum items shall be item totals only; if any unit price for a lump sum item is included in a bid and it differs from the item total, the items total shall prevail.

Standard Specifications Section 3-1.02B, “Tied Bids,” is replaced with:

3-1.02B Tied Bids

The Department breaks a tied bid with a coin toss.

Standard Specifications Sections 3-1.08, "Small Business Participation Report,” and 3-1.11, "Payee Data Record,” are deleted.

3.02 Award of Contract

To the fullest extent provided by law, the City reserves the right to waive any irregularities and/or informalities in any bid received.

The award of the contract, if it be awarded, will be to the lowest responsive and responsible bidder whose proposal complies with all the requirements prescribed. Such award, if made, will be made within forty-five (45) days after the opening of the proposals. If the lowest responsible bidder refuses or fails to execute the contract, the City may award the contract to the second lowest responsive and responsible bidder. Such award, if made, will be made within sixty (60) days after the opening of proposals. If the second lowest responsible bidder refuses or fails to execute the contract, the City may award the contract to the third lowest responsive and responsible bidder. Such award, if made, will be made within seventy-five (75) days after the opening of the proposals. The periods of time specified above within which the award of contract may be made shall be subject to extensions for such further periods as may be agreed upon in writing between the City and the bidder concerned.

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

3.03 Contract Bonds

Standard Specifications Section 3-1.05, “Contract Bonds (Pub Cont Code Sections 10221 and 10222),” is replaced with the following:

The surety or sureties on all bonds furnished must be approved by the City. Any modifications or alteration made in the plans or specifications shall not operate to release any surety from liability on any bond or bonds herein required to be given. All contract bonds shall be payable to the City of Burlingame and shall reference the project name and number.

All alterations, extensions of time, extra and additional work, and other changes authorized by these specifications or any part of the contract may be made without securing the consent of the surety or sureties on the contract bonds.

(a) Faithful Performance Bond

Contractor shall provide, at the time of the execution of the contract for the work, and at its own expense, a surety bond in an amount equal to at least one hundred percent (100%) of the contract price as security for the faithful performance of the contract.

(b) Contractor's Payment (Labor and Materials) Surety Bond
Contractor shall also provide, at the time of the execution of the contract for the work, and at its own expense, a separate surety bond in an amount equal to at least one hundred percent (100%) of the contract price as security for the payment of all persons performing labor and furnishing materials in connection with this contract; a sample is attached at the end of this section.

(c) Maintenance Bond
The Contractor shall furnish a Corporate Surety Maintenance Bond for faulty workmanship and materials in the amount of ten percent (10%) of the total contract cost. This bond shall be for the term of one year after completion and acceptance of the work and shall be delivered to the Engineer before acceptance of the contract.

3.04 Agreement Execution

The Contractor shall sign and return the contract agreement and furnish required bonds and insurance certificates within ten (10) working days after the date of the letter of Notice of Contract Award. If the insurance and bonds are not provided within this time period, the City may proceed to declare the bid bond forfeited and award the bid to another bidder.

3.05 Return of Proposal Guaranties

Bidders' attention is directed to Standard Specifications Section 3-1.19, "Bidders' Securities."

3.06 Insurance

BIDDERS' ATTENTION IS DIRECTED TO THE INSURANCE REQUIREMENTS BELOW AND IN STANDARD SPECIFICATIONS SECTIONS 3-1.07, "INSURANCE POLICIES," and 7-1.06, "INSURANCE."

IT IS HIGHLY RECOMMENDED THAT BIDDERS CONFER WITH THEIR RESPECTIVE INSURANCE CARRIERS OR BROKERS TO DETERMINE IN ADVANCE OF BID SUBMISSION THE AVAILABILITY OF INSURANCE CERTIFICATES AND ENDORSEMENTS AS PRESCRIBED AND PROVIDED HEREIN. IF AN APPARENT LOW BIDDER FAILS TO COMPLY STRICTLY WITH THE INSURANCE REQUIREMENTS, THAT BIDDER MAY BE DISQUALIFIED FROM AWARD OF THE CONTRACT OR THE AWARD MAY BE REVOKED AND SUFFER LOSS OF BID BOND.

Contractor shall procure and maintain for the duration of the Contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, Contractor's agents, representatives,

employees or subcontractors. The cost of such insurance shall be included in the Contractor's bid.

Standard Specifications Section 7-1.06, “Insurance,” is amended to include the following:

(a) Minimum Scope of Insurance

Coverage shall be at least as broad as:

(1) Insurance Services Office form number GL 0002 (Ed. 1/73) covering Comprehensive General Liability and Insurance Services Office form number GL 0404 covering Broad Form Comprehensive General Liability; or Insurance Services Office Commercial General Liability coverage ("occurrence" form GC 0001).

(2) Insurance Services Office form number CA 0001 (Ed. 1/78) covering Automobile Liability, code 1 "any auto" and endorsement CA 0025.

(3) Worker's Compensation insurance as required by the Labor Code of the State of California and Employers Liability insurance.

(b) Minimum Limits of Insurance

Contractor shall maintain limits no less than:

(1) General Liability: $2,000,000 combined single limit per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this Project/location or the general aggregate limit shall be twice the required occurrence limit.

(2) Automobile Liability: $1,000,000 combined single limit per accident for bodily injury and property damage.

(3) Workers' Compensation and Employers Liability: Worker's compensation limits as required by the Labor Code of the State of California and Employers Liability limits of $1,000,000 per accident.

(c) Deductibles and Self-insured Retentions

Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the Contractor shall procure a bond guaranteeing payment of losses and related investigations, claim administration, and defense expenses.

(d) Other Insurance Provision

The policies are to contain, or be endorsed to contain the following provision:

(1) General Liability and Automobile Liability Coverages

(A) The City of Burlingame, its officers, officials, employees and volunteers are to be covered as insureds as respects: liability arising out of activities performed by or on behalf of the Contractor, products and completed operations of the Contractor, premises owned, occupied or used by the Contractor, or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the City of Burlingame, its officers, officials, employees, or volunteers. The endorsement providing this additional insured coverage shall be equal to or broader than ISO Form CG 20 10 11 85 and must cover joint negligence, completed operations, and the acts of subcontractors.

(B) The Contractor's insurance coverage shall be primary insurance as respects the City of Burlingame, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the City of Burlingame, its officers, officials, employees, or volunteers shall be excess of the Contractor's Insurance and shall not contribute with it.

(C) Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the City of Burlingame, its officers, officials, employees, or volunteers.

(D) 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.

(2) Workers' Compensation and Employers Liability Coverage

The insurer shall agree to waive all rights of subrogation against the City of Burlingame, its officers, officials, employees, or volunteers for losses arising from work performed by the Contractor for the City of Burlingame.

(3) All Coverages

Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after thirty days prior written notice by certified mail, return receipt required, has been given to the City of Burlingame.

(e) Acceptability of Insurers

Insurance is to be placed with insurers with a Best's rating of no less than A-:VII and be authorized to conduct business with regard to the profferred lines of insurance in the State of California.

(f) Verification of Coverage

Contractor shall furnish the City with certificates of insurance and with original endorsements effecting coverage required by this clause. The certificates and endorsements for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements are to be on forms approved by the City. All certificates and endorsements are to be received and approved by the City before work commences. The City reserves the right to require complete, certified copies of all required insurance policies, at any time.

(g) Subcontractors

Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.

*** END OF SECTION ***

CONTRACTOR'S PAYMENT (LABOR AND MATERIALS) SURETY BOND
Sample

WHEREAS, the City Council of the City of Burlingame, State of California ("City") and _____, (hereinafter designated as "Principal") have entered into an agreement dated _____, and identified as _____("Agreement"), which is hereby referred to and made a part here of, whereby Principal agrees to install and complete certain designated public improvements; and

WHEREAS, under the terms of said agreement, Principal is required before entering upon the performance of the work to file a good and sufficient payment surety bond with City to secure the claims to which reference is made in Titles 1 and 3 (commencing with Section 8000) of Part 6 of Division 4 of the Civil Code of the State of California.

NOW, THEREFORE, Principal and _____, as Surety, incorporated under the laws of the State of _____, and duly authorized to transact business as an admitted surety, under the Laws of the State of California, are held and firmly bound unto City in the penal sum of _____ dollars ($_____), this amount being not less than one hundred percent of the total amount payable by the terms of the Agreement per Civil Code section 9554, for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

The condition of this obligation is such that if Principal, Principal's subcontractors, heirs, executors, administrators, successors, or assigns shall fail to pay any of the persons, companies, or corporations, referred to in Section 9100 of the California Civil Code, as amended, with respect to any work of labor performed or materials supplied by any such persons, companies, or corporations, which work, labor, or materials are covered by the above-mentioned agreement and any amendments, changes, change order, additions, alterations, or modifications thereof, or any amounts due under the California Unemployment Insurance Code with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Principal and its subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, as amended, with respect to such work and labor, the Surety will pay for the same, in an amount not exceeding the sum herein above specified, and also, in case suit is brought upon this bond, the Surety will pay reasonable attorney's fees in an amount to be fixed by the court.

It is hereby expressly stipulated and agreed that this surety bond shall inure to the benefit of any and all persons, companies, and corporations entitled named in Section 9100 of the California Civil Code, as amended, so as to give a right of action to them or their assigns in any suit brought upon this surety bond.

The Surety hereby stipulates and agrees that no amendment, change, change order, addition, alteration, or modifications to the terms of the agreement of the work to be performed thereunder or the specifications accompanying the same, shall in any way affect its obligations on this surety

bond, and it does hereby waive notice of any such amendment, change, change order, addition, alteration, or modification to the terms of the agreement or to the work performed thereunder or to the specifications accompanying the same. Surety hereby waives the provisions of California Civil Code Sections 2845 and 2849.

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

PRINCIPAL SURETY

By:_____ By:

_____
Address

NOTE: Attach notary acknowledgement for signatures of those executing for Principal and Surety

FAITHFUL PERFORMANCE BOND

Sample

WHEREAS, the City Council of the City of Burlingame, State of California, and _____ (herein designated as "Principal") have entered into an Agreement whereby Principal agrees to construct and complete certain designated public improvements, which said agreement, dated_____, 20_____, and identified as **PROJECT** # _____, is hereby referred to and made a part hereof: and

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

NOW, THEREFORE, we, the Principal and _____, as Surety, are held and firmly bound unto the City of Burlingame (hereinafter called "City"), in the penal sum of _____dollars ($_____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, successors, executors and administrators, jointly and severally, formally by these presents.

The condition of this obligation is such that if the above bounded Principal, his/her or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and provisions in the said Agreement and any alteration thereof made as therein provided, on his or their part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless City, its offices, agents and employees, as therein stipulated, and this obligation shall become null and avoid; otherwise it shall be and remain in full force and effect.

Principal and Surety further agree that upon City's final acceptance of the work, ten percent (10 %) of this bond shall remain in effect to guarantees the repair and/or replacement of defective materials and/or workmanship, one years after City's final acceptance of the work.

As a part of the obligation secured hereby and in addition to the face amount specified therefor, there shall be included costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by City in successfully enforcing such 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 agreement or to the work to be performed thereunder or 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 agreement 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_____20_____.

PRINCIPAL	SURETY
By:_____	By:_____
_____	_____
Address	Address

NOTE: Attach notary acknowledgement for signatures of those executing for Principal and Surety.

SECTION 4. SCOPE OF WORK

4.01 General

Attention is directed to Standard Specifications Section 4, “Scope of Work,” and these Special Provisions.

4.02 Value Engineering

The last paragraph of Section Standard Specifications 4-1.07C, “Value Analysis Workshop.” is replaced with:

> The Contractor will be responsible for all workshop costs. The City will not reimburse Contractor for any associated costs with conducting a value analysis workshop.

Attention is directed to the provisions in Standard Specifications Sections 8-1.04, "Start of Job Site Activities," Section 8-1.05, "Time,” and Section 8-1.10, "Liquidated Damages," and these Special Provisions.

4.03 Increases of More than Twenty-Five Percent (25%) of Engineer’s Estimate

The last paragraph in Standard Specifications Section 9-1.06B, “Increases of More Than Twenty-Five Percent,” is amended to read as follows:

“When the compensation payable for the number of units of an item of work performed in excess of 125 percent of the Engineer’s Estimate, is less than $5,000 at the applicable contract unit price, the Engineer reserves the right to make no adjustment in said price if the Engineer so elects, except that an adjustment may be made if requested in writing by the Contractor.

It is the Contractor’s responsibility to continually analyze and apply the estimated quantities provided in the Contract and to use the knowledge gained from site visits, construction, and professional experience, to update the estimated quantities as the work progresses. If and when the Contractor reaches seventy-five percent (75%) of the estimated quantities of materials required for any portion of the work as specified in the Plans and Specifications and has any reasonable belief that the Contractor will be required to exceed those estimated quantities by more than ten percent (10%), the Contractor shall provide written notice to the Engineer of the possibility and the estimated quantities required to complete the work. If the Contractor fails to provide that written notice before delivering materials in excess of the originally estimated quantities, the Contractor shall not be entitled to any additional compensation or payment for the additional work or materials needed for the additional materials above one hundred and ten percent (110%), but nevertheless shall be required to complete the work.”

4.04 Changes Initiated by the City

The City reserves the right to change the scope of this contract to accommodate budget constraints. The City shall have full authority and discretion to determine the decrease or increase in quantities required as well as the sub-projects that will be altered, added, or deleted. The Contractor shall not be entitled to any additional compensation or adjustment in the unit prices bid because of the above-stated rights.

*** END OF SECTION ***

SECTION 5. CONTROL OF WORK

5.01 General

The control of the work shall be in conformance with Standard Specifications Section 5, “Control of Work,” , except as herein amended.

The following sections in the Standard Specifications are deleted:

Section 5-1.09, "Partnering”
Section 5-1.13C, "Disabled Veteran Business Enterprises"
Section 5-1.13D, "Non-Small Businesses"
Section 5-1.27E "Change Order Bills"
Section 5-1.43E "Alternative Dispute Resolution"

5.02 Coordination and Interpretation of Plans, Specifications and Special Provisions

Standard Specifications Section 5-1.02, “Contract Components,” is replaced with the following:

5-1.02 CONTRACT COMPONENTS

A component in one Contract part applies as if appearing in each. The parts are complementary and describe and provide for a complete work.

If a discrepancy exists:

1. The governing ranking of Contract parts in descending order is:
   - 1.0 Proposal, and Agreement
   - 1.1 Supplementary General Conditions of the Special Provisions
   - 1.2 General Conditions of the Special Provisions
   - 1.3 Technical Specifications of the Special Provisions
   - 1.4 Project plans
   - 1.5 City of Burlingame Standard Details
   - 1.6. Standard Specifications
   - 1.7 (State) Standard Plans
   - 1.8 Supplemental project information
2. Written numbers and notes on a drawing govern over graphics
3. A detail drawing governs over a general drawing
4. A specification in a section governs over a specification referenced by that section

In the event of a discrepancy between units shown on plans, in the special provisions and in the proposal, the units shown in the proposal shall govern.

If a discrepancy is found or confusion arises, submit an RFI.

5.03 Superintendence

Standard Specifications Section 5-1.16, “Representative,” is amended to include the following:

The Contractor's representative shall be available to personally talk to the Engineer within any eight (8) hour period when work is being performed on the project. A telephone number for such purpose shall be given to the Engineer at the start of the project.
The Contractor shall furnish to the Engineer the telephone number of a representative or answering service which will be responsible for responding to emergency calls (e.g., barricade replacement) from the Engineer during non-scheduled working hours.

If the Contractor fails to respond and correct the emergency condition within three (3) hours, and if, in the judgment of the Engineer, correction of the emergency condition should not be deferred until the next regularly scheduled working day, then the Engineer shall have the right to make appropriate arrangements to correct such emergency condition and charge the cost thereof to the Contractor.

5.04 Inspection

The following is added to Standard Specifications Section 5-1.01, "General:" :

The Contractor shall not perform any work during weekend days or City Holidays without the written permission of the Engineer. A fine of $5000 per violation will be deducted from the next progress payment should the Contractor perform unauthorized weekend or Holiday work.

The Contractor shall pay for all inspections required to be performed by City employees due to the scheduling of work by the Contractor between 5:00 P.M. and 8 A.M. on weekdays, and anytime on Saturdays, Sundays and City Holidays, and shall include travel time of the inspector.

City holidays are as follows:

*New Year's Day
*Martin Luther King's Birthday
*President's day
*Memorial Day
*Independence Day
*Labor Day
Columbus Day
*Veteran's Day
*Thanksgiving Day
Day After Thanksgiving
½ Day Christmas Eve
*Christmas Day
½ Day New Year's Eve

*Indicates holidays covered by "Construction Hours" restrictions of these Special Provisions Section 7.02.

Contact the City of Burlingame to determine the specific holiday dates for the current calendar year.

Holidays falling on Saturday or Sunday will be observed on Friday or Monday, respectively.

5.05 Payments to Subcontractors

The following is added to Standard Specifications Section 5-1.13A, "General," :

The Contractor shall comply with the provisions in Business and Professions Code Section 7108.5 concerning prompt payment to subcontractors.

The Contractor shall furnish a written statement showing all work to be subcontracted, giving the names and addresses of all subcontractors and a description of each portion of the work to be subcontracted. The Designation of Subcontractors statement shall be on the form furnished by the City as part of the Bid documents and shall be considered an integral part of those documents.

Pursuant to Public Contract Code Section 6109, no contractor or subcontractor that is ineligible under Labor Code Section 1777.1 or 1777.7 may bid or work on this project. Any contract entered into between the Contractor and such an ineligible subcontractor is void as a matter of law. A debarred subcontractor may not receive any public money for performing work as a subcontractor on this project, and any public money that may have been paid to a debarred subcontractor by the Contractor on the project shall be returned to the City. The Contractor shall be responsible for the payment of wages to workers of a debarred subcontractor who has been allowed to work on the project.

5.06 Permits

The Contractor shall obtain all permits, licenses, bonds, pay all charges and fees (including inspection fees); and other authorization required by all affected jurisdictions involved in this job, at its own expense, unless otherwise specified in Supplementary General Conditions of these Special Provisions. The City's issuance of permits shall not relieve the Contractor of its responsibility as described in this section.

City permits, if required, shall have all fees waived, except for City business licenses. All subcontractors performing work within the limits of the City of Burlingame shall also obtain a City Business Licenses in accordance with these Special Provisions Section 5.07, "City Business License."

Compliance with NPDES Permit. The Contractor shall comply with all requirements of the permit and shall not, directly or indirectly, cause a sanitary sewer overflow or prevent the City from complying with the requirements of the permit. Penalties imposed on the City as a result of any discharge violation caused by the actions of the Contractor, or its employees, or subcontractors shall be borne in full by the Contractor, including fines, legal fees, and other expenses to the City resulting directly or indirectly from such discharge violations. The City may recover such sums by deduction from the construction progress payments.

5.07 City Business License

The Contractor and all Subcontractors are required to have City business licenses in accordance with the Burlingame Municipal Code. Business license information is available at https://www.burlingame.org/index.aspx?page=3307

5.08 Engineering Submittals

The following shall be added to Standard Specifications Section 5-1.23A, "General:"

Contractor's failure to make submittals in a timely manner will not be a basis for any time extensions and shall count against the Contractor's work days.

5.09 Project Appearance

The following shall be added to Standard Specifications Section 5-1.31, "Job Site Appearance:"

"PROJECT APPEARANCE. The Contractor shall maintain a neat appearance at the job site.

In any area visible to the public, the following shall apply: when practical, broken concrete and debris developed during the clearing and grubbing shall be disposed of concurrently with its removal. If stockpiling is necessary, the material shall be removed or disposed of weekly, unless otherwise granted by the City.

The Contractor shall furnish portable toilets for workmen and trash bins for all debris from structure construction. All debris shall be placed in trash bins daily. Forms or false work that are to be reused shall be stacked neatly concurrently with their removal. Forms and false work that are not to be reused shall be recycled concurrently with their removal.

5.10 Lines and Grades

Standard Specifications Section 5-1.26, "Construction Surveys," is replaced with the following:

Contractor shall perform all necessary construction surveys. Construction surveys shall be done in accordance with Chapter 12, "Construction Surveys," of the California Department of Transportation's *Survey Manual.*

All work shall be constructed to the lines and grades shown on the contract drawings. Unless authorized by the Engineer, any work done without construction survey line and grade will be done at the Contractor's risk.

5.11 Project Plans

Four (4) full-size sets of the project plans will be supplied to the successful bidder without charge. Additional sets will be supplied at the cost of reproduction.

5.12 Construction Area Lighting

The Contractor shall ensure that all working areas utilized during darkness are lighted to conform to the minimum illumination intensities established by California Division of Occupational Safety and Health Construction Safety Orders. In addition, the Contractor shall ensure that the lighting provides adequate safety to pedestrians in permitted portions of the construction area.

All lighting fixtures shall be mounted and directed in a manner precluding glare to approaching traffic.

5.13 Areas for Contractor's Use

The second and third paragraphs of Standard Specifications Section 5-1.32, "Areas of Use," are replaced with the following:

> If no City-owned or City-secured area is designated on the plans for the Contractor's use, the Contractor will be responsible to secure additional staging/stockpiling areas at Contractor's own expense in order to perform the work.
>
> The Contractor shall defend, indemnify, and hold the City harmless for any damage to or loss of materials or equipment in conformance with the indemnification requirements in the City's construction agreement.

5.14 Nonhighway Facilities

Standard Specifications Section 5-1.36D, "Nonhighway Facilities." is amended to include the following:

> Unless otherwise permitted by the Engineer, the Contractor shall conduct its operations in a manner which will permit continuous operation of all utility facilities. The Contractor shall contact Underground Services Alert (USA) at 811 or 800-642-2444 at least forty-eight (48) hours before excavation so that underground facilities may be marked in the field. Locations of existing utility mains and utility connections, if shown on the plans, are only approximate. The Engineer assumes no responsibility for accuracy or completeness of said data, which is offered solely for the convenience of the Contractor. If the Contractor finds that a known utility has not marked the job site with either locations or no facilities, Contractor shall be responsible for contacting the utility, or USA regarding the discrepancy before proceeding with work.
>
> Attention is directed to the possible existence of underground main or trunk line facilities not indicated on the plans or in the special provisions. The Contractor shall ascertain the exact location of underground main or trunk lines whose presence is indicated on the plans or in the special provisions, the location of their service laterals or other appurtenances and of existing service lateral or appurtenances of any other underground facilities which can be inferred from the presence of visible facilities such as buildings, meters and junction boxes prior to doing work that may damage any of such facilities or interfere with their service.

If the Contractor discovers underground main or trunk lines not indicated on the Plans or in the special provisions, it shall immediately give the Engineer and the Utility Company written notification of the existence of such facilities. Such mains or trunk lines shall be located and protected from damage as directed by the Engineer and the cost of such work will be paid for as extra work as provided in Section 4-1.05. Damage due to the Contractor's failure to exercise reasonable care shall be repaired at its cost and expense.

5.15 Acceptance of Contract

Standard Specifications Section 5-1.46, "Inspection and Contract Acceptance," is amended to include the following:

However, nothing in this Section 5-1.46 shall be construed to relieve the Contractor of full responsibility for correcting or replacing defective work or materials found at any time before the expiration of the one-year maintenance bond required under Section 3.03 of these Special Provisions.

5.16 Availability of Plans

Contractor shall maintain on the job site at a specific location an official set of Contract Documents, readily available at all times to the Engineer or Inspector.

*** END OF SECTION ***

SECTION 6. CONTROL OF MATERIALS

6.01 General

Attention is directed to Standard Specifications Section 6, "Control of Materials," and these Special Provisions.

6.02 City-Furnished Materials

City-furnished materials shall be furnished in conformance to Standard Specifications Section 6-1.02 and as described herein.

The City-furnished materials on this project, if any, are listed in Section 2, “Supplementary General Conditions,” of these Special Provisions.

The Contractor shall submit a written request to the Engineer for materials at least forty-eight (48) hours in advance of the date and time of their intended use. The request shall state the quantity and type of each material. Unless otherwise specifically provided in the Special Provisions, City-furnished materials will be stored at the City Corporation Yard at 1361 North Carolan Avenue, Burlingame. Materials will be available for pickup on weekdays, holidays excepted, from 8:00 a.m. to 9:00 a.m. and from 3:30 p.m. to 4:30 p.m.

All City-furnished materials that are not used on the project shall remain the property of the City and shall be returned to the City in as-furnished condition at the locations designated by the Engineer.

Any water use from fire hydrants shall be metered. A cash deposit shall be posted at the City Water Department Office at 501 Primrose Road, Burlingame, California, as assurance that the meter is returned in good condition. Meters shall be obtained from and returned to the Water Department Repair Shop at the City Corporation Yard at 1361 North Carolan Avenue, Burlingame, California,. If the meter is returned in good condition, a refund shall be mailed to the Contractor. Contractor shall also pay for the amount of water used. Water drawn from the City-furnished meter shall only be used for this project.

Any damage to the meters while in the Contractor’s possession shall be its responsibility and deductions will be made from the deposit for repairs to the meters. Meters must be returned to the City within 10 working days after work is completed and payment made for water used prior to final payment.

6.03 Local Materials

The second paragraph of Standard Specifications Section 6-2.04, “Local Materials,” is replaced with the following:

> Testing of local materials to be used in the work for compliance with the specifications will be at the Contractor’s expense.

6.04 Buy America

Standard Specifications Section 6-2.05, “Buy America,” is deleted, unless this is a federally-funded contract.

6.05 Specific Brand or Trade Name and Substitution

Standard Specifications Section 6-3.02, “Specific Brand or Trade Name and Substitution,” is amended to include the following:

The City Engineer’s decision to accept substitution is final.

*** END OF SECTION ***

SECTION 7. LEGAL RELATIONS AND RESPONSIBILITY

7.01 General

This section shall conform to Standard Specifications Section 7, “Legal Relations and Responsibility to the Public,” with the following clarifications and amendments. The Contractor is responsible for protecting both its work and the public.

7.02 Construction Hours

Contractor shall not (including excavation and grading) work other than between the hours of 8:00 A.M. and 5:00 P.M. on weekdays (see Section 5.04 of these specifications), except in the case of urgent necessity in the interest of public health and safety, and then only with express permission of the Engineer. In the vicinity of any schools, the contractor shall not begin any operation until after 9:00 A.M. when school is in session.

7.03 Excavation Safety

Standard Specifications Section 7-1.02K(6)(b), “Excavation Safety,” is amended to include the following:

If required the Contractor shall submit a trenching and shoring plan signed and stamped by a license civil engineer or licensed geotechnical engineer for approval by the City. The plan shall include trenching and shoring support calculations.

Designate a competent person to be on site at all times while trench excavation work is being performed. The competent person shall be certified and make daily inspection in accordance with all OSHA requirements. A competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them.

Additionally, the Contractor shall provide upon request by the Engineer calculations and details proving the adequacy of any proposed steel plate trench or excavation bridging to carry traffic loads.

The Contractor shall comply with Public Contract Code § 7104 while excavating.

7.04 Assignment of Antitrust Actions

The Contractor's attention is directed to Standard Specifications Section 7-1.02L(2), “Antitrust Claims.”

7.05 Highway Construction Equipment

Attention is directed to Standard Specifications Section 7-1.02O, "Vehicle Code."

7.06 Sound Control Requirements

Sound control shall conform to the provisions of Standard Specifications Section 14-8, "Noise and Vibration," and these special provisions.

The Contractor shall keep noise pollution due to construction activities as low as possible. In no case shall noise levels produced by the Contractor exceed either of the following maximums:

A. No individual piece of equipment shall produce a noise level exceeding 85dBA at a distance of 25 feet.

B. The noise level at any point outside of the property line or temporary construction area shall not exceed 85dBA. No equipment violating these standards will be allowed to operate.

In no case shall the Contractor's operations violate the noise ordinance (Municipal Code Chapter 10.40).

This noise level requirement shall apply to all equipment on the job or related to the job, including, but not limited to, trucks, transit mixers or transient equipment that may or may not be owned by the Contractor. The use of loud signals shall be avoided in favor of light warnings, except those required by safety laws for the protection of personnel.

7.07 Relations with Property Owners

The Contractor shall notify, in writing, property owners or residents at least forty eight (48) hours in advance of all work affecting access into and out of their property or place of business.

Forms for such notices will be provided to the Contractor at start of construction and shall be distributed to the property owners by the Contractor throughout the length of the Contract, whenever appropriate.

Concrete pouring shall be scheduled to re-open new and replace concrete driveways within seventy-two (72) hours after being closed.

Access to any place of business shall be maintained at all times and shall be coordinated with the business owner. Complete closure of any business access shall be only as approved in writing by the Engineer.

7.08 Public Convenience

Section 7-1.03 "Public Convenience" shall be amended by adding the following:

Attention is directed to Section 7 of the Standard Specifications regarding the fact that the Contractor is responsible for protecting both its work and the public.

The Contractor shall conduct his operations in a manner to minimize inconvenience to the homeowners, residents and the traveling public.

Closed driveways shall be re-opened for safe passage of vehicle and pedestrians by end of the each work shift.

Closed driveways during working hours shall be reopened temporarily as requested by property owners or residents to allow access to their driveways. The Contractor shall re-open the closed driveway within ten minutes (10) of such request.

Access to any place of business shall be maintained at all times and shall be coordinated with the business owner. Complete closure of any business access shall be only as approved in writing by the Engineer.

The Contractor shall conduct his operations in a manner to minimize inconveniences to property owners and residents and to avoid damage on private property. The Contractor shall maintain property owner and resident access to the homes at all times. The Contractor shall keep the work site on the private property in a tidy and neat manner. The Contractor shall remove all tools, equipment and material from the property at the end of each workday.

7.09 Indemnification

Contractor shall indemnify, defend, and hold the City, its directors, officers, employees, agents, and volunteers harmless from and against any and all liability, claims, suits, actions, damages, and causes of action arising out of, pertaining or relating to the actual or alleged negligence, recklessness or willful misconduct of Contractor, its employees, subcontractors, or agents, or on account of the performance or character of the services, except for any such claim arising out of the sole negligence or willful misconduct of the City, its officers, employees, agents, or volunteers. It is understood that the duty of Contractor to indemnify and hold harmless includes the duty to defend as set forth in section 2778 of the California Civil Code. Notwithstanding the foregoing, for any design professional services, the duty to defend and indemnify City shall be limited to that allowed by state law. Acceptance of insurance certificates and endorsements required under this Agreement does not relieve Contractor from liability under this indemnification and hold harmless clause. This indemnification and hold harmless clause shall apply whether or not such insurance policies shall have been determined to be applicable to any of such damages or claims for damages.

*** END OF SECTION ***

SECTION 8. PROSECUTION AND PROGRESS

8.01 General

Prosecution and progress shall conform to Standard Specifications Section 8, “Prosecution and Progress,” and these Special Provisions.

8.02 Progress Schedule

The work to be done shall be performed in stages to minimize the inconvenience to the public.

The Contractor shall develop and maintain the appropriate level critical path method schedule for this project in compliance with Standard Specifications Section 8-1.02, “Schedule.” In addition to the required schedule reports to be submitted to the City in accordance with Standard Specifications Section 8-1.02, “Schedule,” the Contractor shall maintain and furnish to the Engineer on a weekly basis a “three week look ahead” report detailing planned work for the following three weeks, highlighting critical path items of work.

8.03 Start of Job Site Activities

The Contractor shall sign and return the Contract Documents and furnish required bonds and insurance certificates within ten (10) working days after the date of the Notice of Contract Award. If the insurance and bonds are not provided within this time period, the City may declare the bid bond forfeited and award the bid to another bidder. Alternatively, the City may begin to count the elapsed time as “working days” under the Agreement.

The Contractor shall be able to begin work within fifteen (15) calendar days after receiving notice that the Contract has been approved by the City of Burlingame and shall diligently prosecute the same to completion before the expiration of the number of working days as set forth in the "Notice to Bidders." The "Notice to Proceed" shall indicate the "Beginning of Work" date to be used to determine the date of completion.

The “Notice to Proceed” will be given at the preconstruction meeting and will indicate the “Beginning of Work” date to be used to calculate the date of completion.

Even though the counting of working days may have begun, the Contractor shall not begin work before the preconstruction conference. The Contractor shall furnish all specified submittals to the Engineer at, or prior to, the preconstruction conference and shall obtain all specified approvals contained in the Standard Specifications and these Special Provisions prior to the beginning of job site activities.

8.04 Liquidated Damages

The Contractor’s attention is directed to the Supplementary General Conditions for Liquidated Damages.

8.05 Contractor’s Control Termination

The Contractor’s attention is directed to Standard Specifications Section 8-1.13, "Contractor’s Control Termination" and these Special Provisions.

If the Contractor's control of the work is terminated or it abandons the work and the contract work is completed in conformance with the provisions of Section 10255 of the Public Contract Code, any dispute concerning the amount to be paid to the City by the Contractor or its surety, under the provisions of Section 10258 of said Act, shall be subject to arbitration in accordance with the section of these special provisions entitled "Arbitration." The surety shall be bound by the arbitration award and is entitled to participate in such arbitration proceedings.

8.06 As-Built Data

The Contractor shall submit all information to the Engineer before project acceptance, including legible marked up plans of what was constructed, as required by the Engineer to verify as-built drawings for all permanent project work.

*** END OF SECTION ***

SECTION 9. MEASUREMENT AND PAYMENT

9.01 General

Measurement and payment shall be in conformance with these specifications in Section 9, "Payment," of the Standard Specifications and these Special Provisions.

Contractors' attention is directed to Standard Specifications Section 9-1.03, "Payment Scope," and as amended herein.

The fourth paragraph in Standard Specifications Section 9-1.03, "Payment Scope," is as follows:

> Full compensation for work specified in divisions I, II and X of the Standard Specifications, and in Sections 1 and 2 of these special provisions is included in the payment for the bid items unless:
>
> 1. Bid item for the work is shown on the Bid Item List.
> 2. Work is specified as change order work.

When an (F) is included after a bid item name on the Bid List, that bid item quantity is a final pay item.

The Contractor shall agree that the approximate quantities shown in the Bid Item List are solely for the purpose of comparing bids. The Contractor's compensation will be computed upon the basis of the actual quantities of work marked by the Engineer and completed, whether they be more or less than those shown in the Bid Item List.

Linear measurement shall be determined from measurements of bid items complete and in place. Unit counts will be made of the unit items complete and in place. Weight measurements will be based on weight receipts issued by a qualified weight master. Any other method of establishing the quantities not listed specifically herein, or defined in other portions of the contract provisions, shall be determined by referring to the applicable section of the Standard Specifications.

9.02 Payment Adjustments for Price Index Fluctuations

Standard specifications Section 9-1.07, "Payment for Adjustments for Price Index Fluctuations," is deleted, unless otherwise specified in the Supplementary Conditions.

9.03 Lump Sum Bid Item Progress Payments

The first paragraph of Standard Specification Section 9-1.16B, "Schedule of Values," isamended to include the following:

> If a schedule of values is not specified to be submitted or a payment breakdown is not provided in the payment clause of the applicable Standard Specifications or these Special Provisions, progress payments for lump sum bid items will be a percentage of the lump sum

bid item price based on the Engineer's determination of the amount of lump sum work already performed. At Contractors option, submit a lump sum breakdown that provides sufficient detail for the Engineer to determine the value of work performed. The Engineer may consider but not exclusively base the determination of progress payments on Contractors lump sum breakdown. The Engineer's determination of progress payments for lump sum bid items under the Contract will be final in accordance with Standard Specifications Section 5-1.03.

9.04 Materials On-Hand

Standard Specifications Section 9-1.16C, "Materials on Hand," is replaced by the following:

No partial payment will be made for any materials on hand which are furnished but not incorporated in the work.

9.05 Mobilization

Standard Specifications Section 9-1.16D, "Mobilization," is replaced with the following:

9-1.16D Mobilization

Public Contract Code Section 10104 defines "mobilization." The Contractor is eligible for partial payments for mobilization if the Contract includes a bid item for mobilization. The Department will make partial payments no less often than as specified under Public Contract Code Section 10264. If the Contract does not include a mobilization bid item, mobilization is included in the payment for the various bid items.

9.06 Retentions

Standard Specifications Section 9-1.16F, "Retentions," is replaced with the following:

9-1.16F Retentions

The City shall retain 5 percent of the estimated value of the work done and 5 percent of the value of materials so estimated to have been furnished and delivered and unused or furnished and stored as aforesaid as part security for Contractors fulfillment of the contract.

Pursuant to Public Contract Code Section 22300, the Contractor will be permitted, at its request and sole expense, to substitute securities for any monies withheld by the City to ensure performance under the contract. Said securities will be deposited either with the City or with the state or federally chartered bank as escrow agent. Securities eligible for this substitution are those listed in Government Code Section 16430 or bank or savings and loan certificate of deposit, interest-bearing demand deposit accounts, standby letters of credit, or any other mutually agreed to by Contractor and the City. The Contractor shall be the beneficial owner of any securities substituted for monies withheld and shall receive any interest thereon.

9.07 Progress Payments

On or before the first day of every month the Contractor and Engineer shall meet and prepare a written estimate of progress payments. From this amount, five percent (5%) will be deducted and, from the remaining ninety five percent (95%), there will be deducted any amounts due City from Contractor for supplies, materials, services, damages or otherwise deductible under the terms of the contract and the amount of all payments previously made to Contractor. The remainder will be paid by the City to the Contractor as a progress payment by the 20th day of the month. The remaining five percent (5%) thereof shall be paid to Contractor thirty-five (35) days after the recording of the Notice of Completion.

Pursuant to Public Contract Code Section 20104.50, the City will promptly process all requests for progress payments pursuant to this contract. As to any undisputed payments that are made more than thirty (30) days after receipt of an undisputed and properly submitted payment request from the Contractor, the City will pay interest equivalent to the legal rate set forth in Code of Civil Procedure Section 685.10.

9.08 Final Payment After Contract Acceptance

Standard Specifications Section 9-1.17D (1), "General" is amended to include the following:

Upon satisfactory completion of the entire work, the Engineer will recommend the acceptance of the work to the City Council. If the City Council accepts the completed work, it will cause a Notice of Completion to be recorded with the County Recorder.

Thirty-five days after the filing of the Notice of Completion, the Contractor will be entitled to the balance due for the completion and acceptance of the work, if certification is made by sworn written statement that all claims have been filed with the City based upon acts or omissions of the Contractor and that no liens or withhold notices have been filed against said work or the property on which the work was done.

9.09 Claim Resolution

Any claim by the contractor in connection with this project shall be resolved pursuant to Section 9204 of the Public Contract Code; the full text of which is as follows:

SECTION 1. Section 9204 is added to the Public Contract Code, to read:

(a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.

(b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.

(c) For purposes of this section:

(1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

(A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

(B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

(C) Payment of an amount that is disputed by the public entity.

(2) "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

(3)

(A) "Public entity" means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) "Public entity" shall not include the following:

(i) The Department of Water Resources as to any project under the jurisdiction of that department.

(ii) The Department of Transportation as to any project under the jurisdiction of that department.

(iii) The Department of Parks and Recreation as to any project under the jurisdiction of that department.

(iv) The Department of Corrections and Rehabilitation with respect to any project under its jurisdiction pursuant to Chapter 11 (commencing with Section 7000) of Title 7 of Part 3 of the Penal Code.

(v) The Military Department as to any project under the jurisdiction of that department.

(vi) The Department of General Services as to all other projects.

(vii) The High-Speed Rail Authority.

(4) "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d)

(1)

(A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2)

(A) If the claimant disputes the public entity's written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

(B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If

mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.

(C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

(D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.

(E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.

(3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.

(4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.

(5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.

(e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.

(f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements

in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.

(g) This section applies to contracts entered into on or after January 1, 2017.

(h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

(i) This section shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2020, deletes or extends that date.

9.10 Adjustment of Overhead Costs

Irrespective of the final payment to be made to the Contractor under this contract, there will be no adjustment of overhead costs.

9.11 Damages

Any provision in the Contract which limits the City's liability to an extension of time for delay for which the City is responsible and which delay is unreasonable under contemplation of the circumstances involved, and not within the parties', shall not be construed to preclude the recovery of damages by the Contractor or subcontractor. This section shall not be construed to void any provision in this Contract which requires notice of delays, provides for arbitration or other procedure for settlement, or provides for liquidated damages.

9.12 Compensation for General Conditions and Supplementary General Conditions

Compensation for doing any work under the General and Supplementary General Conditions shall be included in the various items of work, and no additional payment shall be made.

*** END OF SECTION ***

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SUPPLEMENTARY GENERAL CONDITIONS

The General Conditions and Standard Conditions are hereby amended as follows:

1. Section 6.02 of the General Conditions is amended by adding the following:

   "The City-furnished materials for this project are:

   - NONE"

2. Section 8.04 of the General Conditions is amended by adding the following:

   "Contractor's failure to achieve substantial completion of the work described in the Contract Documents will cause the City to incur losses of types and in amounts which are impossible to compute and ascertain with certainty. The Contractor shall pay to the City of Burlingame liquidated damages in the amount of One Thousand Dollars ($1,000) per day for each day and every calendar days' delay in finishing the work in excess of the number of days (180) referred to in these specifications. The amount may be assessed and recovered by the City as against Contractor and its Surety. Such liquidated damages are intended to represent estimated actual damages and are not intended as a penalty, and Contractor shall pay them to the City, without limiting City's any of the City's rights as provided in the Contract Documents."

*** END OF SECTION ***

*** END OF SECTION ***

SPECIFICATIONS

The City of Burlingame

Central County Fire Department
Fire Station 35 Improvements

100% Construction Documents

SEPTEMBER 14, 2018

Kitchell CEM
2450 Venture Oaks Way, Suite 500
Sacramento, California 95833

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SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.5 ALLOWANCES

A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 Schedule of Allowances

A. Allowance No. 1: Include sum of $5000 for replacing damaged wood to rear deck of building and installation of same. Provide replacement cost of wood in board foot units as outlined in Section 012200 Unit Prices, Unit Price No. 1.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

B. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1 – Replace wood decking at rear patio.
   1. Description: Wood Preservative Treated Lumber according to Section 06 10 00 – Rough Carpentry. Size of members is 2 x 6 to match existing. Price is to include fastening the board with two screw attachments suitable for exterior exposure on each existing joist to match existing. The board shall be direct replacement lengthwise of the existing board.
   2. Unit of Measurement: Board foot.
   3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ALTERNATES SCHEDULE

Alternate 1: Replace roofing and skylights and related flashing and rainwater collection system.

Alternate 2: Repaint exterior walls, soffits, and fascia, and provide new windows and patio door of the Living Spaces (Rooms 101, 102, and 103) and Apparatus Bay (Room 104), and refinish the rear deck.

Alternate 3: Provide fire line connection to the city main, and sprinkler and fire alarm systems for the Sleeping Quarters.

Alternate 4: Replace the east tank water heater in basement with a tankless water heater.

Alternate 5: Provide mechanical cooling system for the Basement Utility room.

Alternate 6: Paint interior walls, ceiling, and trim of rooms Apparatus Bay 104 and utility 104A.

END OF SECTION 01 23 00

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit California General Permit or authorities having jurisdiction, whichever is more stringent.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
   1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
   2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.5 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. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, and California Building Code, latest edition**.**

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

B. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Toilet Facilities: For the exclusive use of the Fire Station staff, provide prefabricated or mobile restroom units with serviceable impervious finishes, and temperature controls. A minimum of two compartments each supplied with a toilet and lavatory must be provided.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to storage tanks which is regularly vacuumed by tank trucks.

C. Sanitary Facilities: Provide temporary toilets, wash 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.

D. 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 according to coordination drawings.
      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.

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. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in condition acceptable to the Owner.

3.3 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.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction California General Permit or authorities having jurisdiction, whichever is more stringent.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
   2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrance to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

G. 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.

H. Temporary Partitions: Provide floor to ceiling dustproof partitions with gypsum wallboard to limit dust and dirt migration and to separate areas occupied by the Owner from fumes and noise. Where fire-resistance temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.

I. 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 on the site.

3.4 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 01 50 00

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SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Recycling nonhazardous waste.
   2. Disposing of nonhazardous waste.

1.3 DEFINITIONS

A. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

B. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of minimum 60 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit City of Burlingame "Recycling and Waste Reduction Form" along with associated permit fee prior to issuance of the building permit.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for recycled waste. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.

6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Qualification Data: For waste management coordinator.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 RECYCLING WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: Refer to City of Burlingame Recycling Resources listed in their handout with the Recycling and Waste Reduction Form.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner and Contractor.

D. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

E. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from the weather.
   5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.3 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

E. Samples: Vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.

4. Steel reinforcement and accessories.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301.
   2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better.
      b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
      c. Structural 1, B-B or better; mill oiled and edge sealed.
      d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
   3. Overlaid Finnish birch plywood.

B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Welded-Wire Fabric Reinforcement: ASTM A 185/A 185M.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

C. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type I or II, uniform color for all exposed concrete.
   2. Fly Ash: ASTM C 618, Class F.

D. Normal-Weight Aggregates: ASTM C 33/C 33M coarse aggregate.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Air-Entraining Admixture: ASTM C 260/C 260M.

F. Water: ASTM C 94/C 94M and potable.

G. Air-Entraining Admixtures: ASTM C 260/C 260M.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type D - for use in hot weather, and Type A - for use in cool weather.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Meadows, W.R., Inc.; Perminator 15 mil.
      b. Stego Industries, LLC; Stego Wrap 15 mil Class A.

c. As approved by Equal.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
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. BASF Construction Chemicals - Building Systems; Confilm.
b. Euclid Chemical Company (The), an RPM company; EUCOBAR.
c. Meadows, W. R., Inc.; EVAPRE.
d. Sika Corporation.; SikaFilm.
e. SpecChem, LLC; SpecFilm.
f. As approved by Architect.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Submit product for approval by Architect prior to use.

2.8 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
1. Sonneborn "Sonobond"; the Euclid Chemical Company "Euco-Weld"; Larsen Products Corp., "Weld-Crete" or approved equal.

B. Joint former: Burke zip strip joint formers or approved equivalent.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 318 Section 26.4.2 and 26.4.3 for approval prior to beginning concrete work.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
2. All concrete mix designs shall be signed by a Civil or Structural Engineer registered in California.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 15 percent.

2.10 CONCRETE MIXTURES

A. All structural concrete: Normal-weight concrete.
   1. Minimum Compressive Strength: 3000 psi at 28 days.
   2. Maximum W/C Ratio: 0.45 for slab on grade, 0.5 for foundations.
   3. Slump Limit: 3 inches (8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticising admixture), plus or minus 1 inch.
   4. Air Content: 3 percent, plus or minus 1.5 percent.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
   1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened concrete surfaces.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.9 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

B. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 03 30 00

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Wall, roof and floor sheathing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. New materials forming the work. Do not utilize previously used materials.

B. Products specified by Reference Standards or by description only: any product meeting those standards or description.

C. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Dress lumber, S4S, unless otherwise indicated.

D. Maximum Moisture Content of Lumber: 19 percent maximum moisture content at time of installation.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4c for items in contact with ground.
   1. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat exposed framing and framing where indicated on the drawings.

2.3 LUMBER & TIMBER MATERIALS

A. Beams 6x and thicker and posts 6x6 and larger: Douglas Fir-Larch species, Select Structural grade.

B. All other framing not otherwise indicated: Douglas Fir-Larch species, No. 1 grade.

C. Wall studs: Douglas Fir-Larch species, No. 1 grade.

D. Sill Plates: Pressure Preservative treated Douglas Fir-Larch, No. 1 grade.

E. 1x Roof or Wall Sheathing Boards: Douglas Fir-Larch species, No. 1 grade.

2.4 SHEATHING MATERIALS

A. Plywood Roof Sheathing: APA Plywood per PS-1 Structural I, Span Rating as noted: Exposure Durability 1; unsanded, CD.

B. Plywood Wall Sheathing: APA Plywood per PS-1 Structural I, Exposure Durability 1; unsanded CD.

C. Plywood Floor Sheathing: APA Plywood per PS-1 Structural I, Span Rating as noted; Exposure Durability 1; unsanded CD.

D. Telephone and Electrical Panel Boards: APA PS-1 Plywood. APA rated CD, exposure 1.

2.5 UNDERLAYMENT MATERIALS

A. Plywood Underlayment: APA Rated PS-1 plywood Structural I, Exposure Durability 1; unsanded.

2.6 MISCELLANEOUS LUMBER & MATERIALS

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.

B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

E. Subfloor Glue: APA AFG-01, waterproof.

F. Building Paper: No. 15 asphalt felt, or spun bonded polyethylene as directed by the Architect.

2.7 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails: Common steel wire nails per ASTM F1667, all requirements of the 2016 California Building Code, Chapter 23 and the National Design Specifications (NDS).

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1, the requirements of the 2016 CBC, Chapter 23 and the NDS.

E. Lag Screws: ASME B18.2.1, the requirements of the 2016 CBC, Chapter 23 and the NDS.

F. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.

2.8 STRUCTURAL FRAMING CONNECTORS

A. Galvanized Steel, sized to suit framing conditions or as shown on the drawings. Simpson Strong-Tie, or approved equivalent, installed per manufacturer's instructions for maximum rated capacities.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install structural framing connectors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in 2016 California Building Code (CBC).

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
   1. Comply with indicated fastener patterns where applicable.
   2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
   3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.4 SHEATHING

A. Install floor and roof sheathing with face grain direction perpendicular to supports with end joints staggered. Secure sheet edges over center of bearing. Attach floor sheathing with subfloor glue and provide nailing indicated on the drawings

3.5 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 41 16 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.3 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.4 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements

B. See AWI's or WI's member list for names of woodworking firms.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Abet Laminati, Inc.
      b. Formica Corporation.
      c. Lamin-Art, Inc.
      d. Panolam Industries International, Inc.
      e. Wilsonart International; Div. of Premark International, Inc.
   2. Laminate colors: Selected from manufacturers standard range.

F. Laminate Cladding for Exposed Surfaces:
   1. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
   2. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Shelves and Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS .
      a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
      b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
   2. Shelves: Plywood with High Pressure Decorative Laminate.
   3. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
   4. Drawer Bottoms: Hardwood plywood.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by laminate manufacturer's designations.
   2. Match City's sample.
   3. As selected by City from laminate manufacturer's full range in the following categories:
      a. Wood grains, matte finish.
      b. Patterns, matte finish.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Softwood Plywood: DOC PS 1; minimum 7 plies through 3/4" finish panel thickness.
   2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:
   1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Back-Mounted Pulls: BHMA A156.9, B02011. 6" centers stainless steel wire pulls.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

E. Drawer Slides: BHMA A156.9.
   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension ; zinc-plated steel with polymer rollers.
   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.

F. Door Locks: BHMA A156.11, E07121.

G. Drawer Locks: BHMA A156.11, E07041.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

I. Counter Brackets: Hebgo Brackets 287.44.477 by Hafele for 24" counters.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify City seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced; ASTM C 665, type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   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. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Owens Corning.

B. Glass-Fiber Blanket, Reinforced-Foil Faced at Wall Types A1 and A2: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
   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. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Owens Corning.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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 to envelop entire area to be insulated. 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.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Building wrap.
   2. Flexible flashing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide the following:
      a. DuPont Building Innovations: E. I. du Pont de Nemours and Company; Tyvek CommercialWrap.
      b. Raven Industries, Inc; Fortress Pro Weather Protective Barrier.
      c. Reemay, Inc; Typar HouseWrap.
   2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
   3. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 20 mil.
   1. Products: Subject to compliance with requirements, provide the following:
      a. DuPont Building Innovations: E. I. du Pont de Nemours and Company; DuPont Flashing Tape.

b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Vycor Butyl Self Adhered Flashing.
c. Protecto Wrap Company; BT-25 XL.
d. Raven Industries, Inc; Fortress Flashshield.

2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:
1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. Lap flashing over nailing flanges of window frame head and jambs where applicable.
6. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 07 25 00

SECTION 07 52 13 - ATACTIC-POLYPROPYLENE (APP) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section is provided to the work as BID ALTERNATE 1.

1.2 SUMMARY

A. Section Includes:
1. Atactic-polypropylene (APP)-modified bituminous membrane roofing.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to Work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For the following products:
1. Cap sheet, of color required.
2. Flashing sheet, of color required.
3. Walkway pads or rolls, of color required.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

1.6 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.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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.

1.7 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Dibiten Poly 4.5 Slate White or comparable product by one of the following:
1. CertainTeed Corporation.
2. Firestone Building Products.
3. GAF Materials Corporation.
4. Johns Manville.
5. Malarkey Roofing Company.

C. Source Limitations: Obtain components including roof insulation, cover board, and fasteners for roofing system from manufacturer approved by membrane roofing manufacturer.

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 G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 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 roofing system, and shall be listed in FM Global' "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: MH.

D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 ROOFING SHEET MATERIALS

A. Roofing Membrane Sheet: ASTM D 6223/D 6223M, Grade S, Type I or II, APP-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); smooth surfaced; suitable for application method specified.

B. Granule-Surfaced Roofing Cap Sheet: ASTM D 6222/D 6222M, Grade G, Type I or II, APP-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
1. Granule Material: Slate.
2. Granule Color: White.

2.4 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ; smooth surfaced; suitable for application method specified.

B. Granule-Surfaced Flashing Sheet: ASTM D 6223/D 6223M, Grade G, Type I or II, APP-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granule surfaced; suitable for application method specified, and as follows:
1. Granule Color: White.

2.5 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings.

C. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

E. Roofing Granules**:** Slate roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing.

F. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.6 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 1/2 inch thick.
   1. Products: Subject to compliance with requirements, provide the following:
      a. CertainTeed Corporation; GlasRoc Sheathing.
      b. Georgia-Pacific Corporation; Dens Deck.
      c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
      d. USG Corporation; Securock Glass Mat Roof Board.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
   5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
      a. Test for moisture by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with Work of this Section if test sample foams or can be easily and cleanly stripped after cooling.
   6. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

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 INSTALLATION, GENERAL

A. Comply with roofing system manufacturer's written instructions.

B. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
   2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
   1. Install roofing system MBA 3-N-L-M, according to roof assembly identification matrix and roof assembly layout illustrations in NRCA's "The NRCA Roofing and Waterproofing Manual" and to Section requirements.

B. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
   1. Deck Type: Adhered.
   2. Base Sheet: One.

C. Start installation of roofing in presence of manufacturer's technical personnel.

D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.6 BASE-SHEET INSTALLATION

A. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
   1. Adhere to substrate in a uniform coating of cold-applied adhesive.

3.7 APP-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing sheets over and terminate beyond cants, installing as follows:
   1. Torch apply to substrate.
   2. Unroll roofing sheets and allow them to relax for minimum time period required by manufacturer.

B. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
   1. Repair tears and voids in laps and lapped seams not completely sealed.
   2. Apply roofing granules to cover exuded bead at laps while bead is hot.

C. Install roofing sheets so side and end laps shed water.

3.8 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:
   1. Prime substrates with asphalt primer if required by roofing system manufacturer.
   2. Flashing-Sheet Application: Torch apply flashing sheet to substrate.

B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

3.9 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

END OF SECTION 07 52 13

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SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Manufactured reglets with counterflashing.
2. Formed low-slope roof sheet metal fabrications.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.

7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches .

1.6 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. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows 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 D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with name of fabricator and design approved by FM Approvals.

D. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressure:

E. Design Pressure: As indicated on Drawings.

F. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   2. Fasteners for Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, 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 C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet; Springlock Flashing System or comparable product by one of the following:
      a. OMG EdgeSystems (formerly Hickman Engineered Systems).
      b. Keystone Flashing Company, Inc.
      c. National Sheet Metal Systems, Inc.
   3. Material: Aluminum, 0.024 inch thick.
   4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
   5. Finish: With manufacturer's standard color coating.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
   1. 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.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: 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-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. 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.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

K. Do not use graphite pencils to mark metal surfaces.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.
   1. Joint Style: lapped minimum 4".
   2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
   3. Fabricate from the Following Materials:
      a. Aluminum: 0.050 inch thick.

B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
   1. Coping Profile: Fig 3-4A according to SMACNA's "Architectural Sheet Metal Manual." Match existing coping profile at the respective buildings.
   2. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
   3. Fabricate from the Following Materials:
      a. Aluminum: 0.050 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches . Roll laps and edges with roller. Cover underlayment within 14 days.

B. Apply slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor 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.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. 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.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

E. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. 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 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof-edge drainage systems.

B. Preinstallation Conference: Conduct conference at Fire Station in Work.
   1. Meet with City, Architect, City's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
   2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
   2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
   3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
   4. Detail termination points and assemblies, including fixed points.
   5. Include details of special conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Warranted materials shall be free of defects in material and workmanship for five years after shipment. If, after inspection, the manufacturer agrees that materials are defective, the manufacturer shall at their option repair or replace them.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ATAS International, Inc.
   2. Hickman Company, W. P.
   3. Metal-Era, Inc.
   4. Perimeter Systems; a division of SAF.

C. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.050 inch thick.
2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and soldered.
4. Gutter Supports: Gutter brackets with finish matching the gutters.
5. Gutter Accessories: Continuous snap-in plastic leaf guard.

D. Downspouts: Plain round complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.040 inch thick.Architectural Products and perhaps other manufacturers offer extruded-aluminum downspouts.

2.2 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
1. Provide elbows at base of downspouts at grade to direct water away from building.

D. Connect downspouts to underground drainage system indicated. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as 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 roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

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SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grace Construction Products.
2. Hilti, Inc.
3. Specified Technologies Inc.
4. 3M Fire Protection Products.
5. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include fire-barrier and smoke barrier walls.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Low-Emitting Materials: Penetration firestopping sealants and sealant primers 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."

D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Temporary forming materials.
   2. Steel sleeves.

2.3 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestopping for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: W-L-1028.
   2. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
   1. UL-Classified Systems: W-L-2242.
   2. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Insulated Pipes:
   1. UL-Classified Systems: W-L-8011.
   2. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Flexible Metallic Electrical Penetrants:
   1. UL-Classified Systems: W-L-1224.
   2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by City.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify City seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the 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.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: 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 specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Dow Corning Corporation; 758.
      b. GE Construction Sealants; Momentive Performance Materials Inc; SCS2350.
      c. Polymeric Systems, Inc..

2.2 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Products: Subject to compliance with requirements, provide the following:
      a. BASF Construction Chemicals - Building Systems; Sonalastic TX1.
      b. Pecora Corporation; Dynatrol I-XL.
      c. Polymeric Systems, Inc.; Flexiprene 1000.
      d. Sika Corporation U.S.; Sikaflex Textured Sealant.
      e. Tremco Incorporated; Dymonic.

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Dow Corning Corporation; 786-M White.
      b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
      c. Tremco Incorporated; Tremsil 200.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Bostik, Inc.; Chem-Calk 300.
      b. Pecora Corporation; BC-158.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide the following:
a. BASF Construction Chemicals - Building Systems; Sonolac.
b. Pecora Corporation; AC-20.
c. Sherwin-Williams Company (The); .
d. Tremco Incorporated; Tremflex 834.

2.6 MISCELLANEOUS MATERIALS

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 Nonporous 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 nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including 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. Porous joint substrates include the following:
a. Concrete.
b. Masonry.
c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.

4. Clean nonporous 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. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. 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 OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated 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 sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   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.

F. Tooling of Nonsag Sealants: 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.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, M, P, 50, T, NT.
   3. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-2.
   1. Joint Locations:
      a. Joints between plant-precast architectural concrete units.
      b. Control and expansion joints in unit masonry.
      c. Joints in dimension stone cladding.
      d. Joints in glass unit masonry assemblies.
      e. Joints in exterior insulation and finish systems.
      f. Joints between metal panels.
      g. Joints between different materials listed above.
      h. Perimeter joints between materials listed above and frames of doors windows and louvers.
      i. Other joints as indicated on Drawings.
   2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.Joint-Sealant Color: As selected by City from manufacturer's full range of colors.
   3. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces JS-3.
   1. Joint Locations:
      a. Isolation joints in cast-in-place concrete slabs.
      b. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, S, P, 25, T, NT.
   3. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-4.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Tile control and expansion joints.
      c. Vertical joints on exposed surfaces of unit masonry walls.
      d. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, S, NS, 25, NT.
   3. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-5.
   1. Control joints on exposed interior surfaces of exterior walls.
   2. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   3. Other joints as indicated on Drawings.
   4. Joint-Sealant: acrylic latex.
   5. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-6.
   1. Joint Locations:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints where indicated.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
   3. Joint-Sealant Color: As selected by City from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics JS-7.
   1. Joint Locations:
      a. Aluminum thresholds.
      b. Sill plates.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Butyl-rubber based.
   3. Joint-Sealant Color: Black.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site no more than two weeks prior to installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:
   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.
   9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work 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 work 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Amweld International, LLC.
   2. Ceco Door; ASSA ABLOY.
   3. Curries Company; ASSA ABLOY.
   4. Fleming Door Products ltd.; Assa Abloy Group Company.
   5. Shanahans Manufacturing Ltd.
   6. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Commercial Doors and Frames: NAAMM-HMMA 861. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Frames:
      a. Materials: Uncoatedsteel sheet, minimum thickness of 0.053 inch.
      b. Frames: Fabricated from same material as adjacent door frame.
      c. Construction: Full profile welded.
   3. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Commercial Laminated Doors and Frames: NAAMM-HMMA 867. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G90 A90 coating.
      d. Core: Polyisocyanurate.
   3. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G90 A90 coating.
      b. Construction: Full profile welded.
   4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application as indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
   1. Kind: Fully tempered where indicated on Drawings.

F. Insulating-Glass Units: ASTM E 2190.
   1. Lites: Two.
   2. Filling: Fill space between glass lites with argon.
   3. Low-E Coating: Pyrolytic on second surface.

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:
   1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
   2. Fire Door Cores: As required to provide fire-protection ratings indicated.
   3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
   4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
   5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
   6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. 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 butt welding.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
   4. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.

4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

5. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
6. 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.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated

2.8 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 SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

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.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and 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. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
   c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
   d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. 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.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.3 ALLOWANCES

A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
   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:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Acudor UF-5000 Universal Access door or comparable product by one of the following:
      a. Babcock-Davis.
      b. JL Industries, Inc.; a division of the Activar Construction Products Group.
      c. Larsens Manufacturing Company.
      d. MIFAB, Inc.
      e. Milcor; Commercial Products Group of Hart & Cooley, Inc.
      f. Nystrom, Inc.
   3. Door Size: 24" x 24" .
   4. Metallic-Coated Steel Sheet for Door: Nominal 0.079 inch (1.59 mm), 14 gage, factory finished.
   5. Stainless-Steel Sheet for Door: Nominal 0.075 inch , 14 gage, No. 4 finish.
   6. Frame Material: Same material as door. Nominal 0.064 inch (1.59 mm), 16 gage metallic-Coated Steel Sheet or Nominal 0.060 inch (1.59 mm), 16 gage for Stainless-Steel.
   7. Latch and Lock: Cam latch, screwdriver operated .

2.2 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

2.3 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.

D. Stainless-Steel Finishes:
   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 32 13 - SLIDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes sliding aluminum-framed glass doors for exterior locations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

B. Shop Drawings: For sliding aluminum-framed glass doors.
   1. Include plans, elevations, sections, and details.
   2. Detail attachments to other work, and between units, if any.
   3. Include hardware and required clearances.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes, weather stripping, operable panels, and operating hardware to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:
   1. Arcadia Architectural Products, Inc.
   2. EFCO Corporation.
   3. Fleetwood Aluminum Products, Inc.
   4. Jeld-Wen, Inc.
   5. C. R. Laurence Co., Inc.
   6. Milgard Manufacturing, Inc.
   7. Wausau Windows and Doors; Apogee Wausau Group, Inc.

C. Source Limitations: Obtain sliding aluminum-framed glass doors from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Product Certification: AAMA certified with label attached to each door.

B. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of Insert value.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.27.

D. Condensation-Resistance Factor (CRF): Provide sliding aluminum-framed glass doors tested for thermal performance according to AAMA 1503, showing a CRF of 45.

E. Thermal Movements: Provide sliding aluminum-framed glass doors, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Sound Transmission Class (STC): Rated for not less than 28 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. Outside-Inside Transmission Class (OITC): Rated for not less than 23 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

2.3 SLIDING ALUMINUM-FRAMED GLASS DOORS

A. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior; with manufacturer's standard finish.
   1. Low-Profile Floor Track: ADA-ABA compliant.

2.4 FABRICATION

A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.

C. Weather Stripping: Provide full-perimeter weather stripping for each door panel.

D. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

F. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding aluminum-framed glass door installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.

B. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

D. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Lubricate hardware and moving parts.

B. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

C. Protect sliding aluminum-framed glass door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact sliding aluminum-framed glass door surfaces, remove contaminants immediately according to manufacturer's written instructions.

D. Refinish or replace sliding aluminum-framed glass doors with damaged finishes.

E. Replace damaged components.

END OF SECTION 08 32 13

SECTION 08 45 13 - STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes aluminum-framed assemblies glazed with structured-polycarbonate panels as follows:
   1. Skylight assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

B. Shop Drawings: For panel assemblies.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

C. Samples: In manufacturer's standard size.
   1. For each type of structured-polycarbonate panel.
   2. For each type of exposed finish for framing members.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each structured-polycarbonate-panel assembly, for tests performed by a qualified testing agency.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies 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. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Water leakage.
   2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

A. Structured-Polycarbonate-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with structured-polycarbonate panels.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide EXTECH/Exterior Technologies, Inc Series #3300 Surface Mounted Polycarbonate Skylight System or comparable product by one of the following:
      a. CPI Daylighting, Inc.
      b. Duo-Gard Industries Inc.
      c. Major Industries, Inc.
      d. Kingspan (formerly Bristolight Daylighting Systems).

2.2 STRUCTURED-POLYCARBONATE PANELS

A. Structured-Polycarbonate Panels: Translucent, extruded-polycarbonate sheet with multiwall cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.
   1. Cell Insulation: Fill cellular cross sections with aerogel.
   2. Panels shall be 20mm (25/32”) thick, and weight shall be nominally 0.66 lbs. per sq. ft.

B. UV Resistance: On outer surface.

C. Color: Clear.

D. Panel Performance:
   1. Plastic Self-Ignition Temperature: 650 deg F or more according to ASTM D 1929.
   2. Smoke-Developed Index: 450 or less according to ASTM E 84, or 75 or less according to ASTM D 2843.
   3. Combustibility Classification: Class CC2 based on testing according to ASTM D 635.
   4. Roof-Covering Classification: Class B brand test according to ASTM E 108 or UL 790.
   5. Interior Finish Classification: Class C based on testing according to ASTM E 84.
   6. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D 2244, after outdoor weathering compliant with procedures in ASTM D 1435.
      a. Outdoor Weathering Conditions: 60 months in Arizona or 120 months in a moderate North American climate.
   7. Impact Resistance: No failure at impact of 200 ft. x lbf according to freefalling-ball impact test using a 3-1/2-inch- diameter, 6.3-lb ball.
   8. Haze Factor: Greater than 90 percent when tested according to ASTM D 1003.

2.3 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
   1. Construction: One piece, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
1. At closures, retaining caps, or battens, use ASTM A 193, 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Framing Gaskets: Manufacturer's standard gasket system with low-friction surface treatment designed specifically for retaining structured-polycarbonate panels.

F. Frame-System Sealants: As recommended in writing by manufacturer.

2.4 FABRICATION

A. Fabricate aluminum components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing through joints and moisture migrating within assembly to exterior.

B. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

C. Reinforce aluminum components as required to receive fastener threads.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.
1. Do not install damaged components.

2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Install components plumb and true in alignment with established lines and elevations.

C. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

D. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

END OF SECTION 08 45 13

SECTION 08 53 13 – VINYL WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes vinyl-framed windows.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review, discuss, and coordinate the interrelationship of vinyl windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
   3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
   4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, glazing, and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for vinyl windows.

B. Shop Drawings: For vinyl windows.
   1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
      b. Structural failures including excessive deflection, water leakage, and air infiltration.

c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:
   a. Window: 10 years from date of Substantial Completion.
   b. Glazing Units: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain vinyl windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Window Certification: WDMA certified with label attached to each window.

B. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

D. Outside-Inside Transmission Class (OITC): Rated for not less than 30 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

2.3 VINYL WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella Corporation 350 Series Casement Window with integral fin or comparable product by one of the following:
   1. Jeld-Wen, Inc.
   2. Kolbe & Kolbe Millwork Co., Inc.
   3. Milgard Manufacturi

B. Operating Types: Provide the following operating types in locations indicated on Drawings:
   1. Casement: Project out.

C. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
   1. Kind: Fully tempered where indicated on Drawings.

D. Insulating-Glass Units: ASTM E 2190.
   1. Lites: Two.
   2. Filling: Fill space between glass lites with argon.
   3. Low-E Coating: Pyrolytic on second surface.

4. Integral Louver Blinds: Glass manufacturer's standard, horizontal louver blinds with aluminum slats and polyester fiber cords, located in space between glass lites, and operated by hardware located on inside face of sash.
   a. Operation: Tilt only.
   b. Color: White.

E. Glazing System:
1. Dual Glazing System:
   a. Interior Lite: Glass.
   b. Exterior Lite: Insulating-glass unit.

F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations.

G. Projected Window Hardware:
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
   a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.
2. Hinges: Stainless-steel hinges with stainless-steel-reinforced, sliding nylon shoes.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 29 inches tall and two arms on taller sashes.
4. Limit Devices: limit devices designed to restrict sash opening.
   a. Limit clear opening to 4 inches for ventilation; with custodial key release.
5. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches above floor.

H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
1. Type and Location: sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
1. Finish for Interior Screens: Baked-on organic coating in color selected by City from manufacturer's full range.
2. Finish for Exterior Screens: match window frames.

C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
1. Wire-Fabric Finish: Charcoal gray.

2.5 FABRICATION

A. Fabricate vinyl windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze vinyl windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Window Assemblies: Provide operating units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
1. Angled mullion posts with interior and exterior trim.
2. Angled interior and exterior extension and trim.
3. Clear pine head and seat boards.
4. Top and bottom plywood platforms.
5. Exterior head and sill casings and trim.
6. Support brackets.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 53 13

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08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
   2. Cylinders for door hardware specified in other Sections.

1.3 COORDINATION

A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
   1. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with the City.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Conference participants shall include Installer's Architectural Hardware Consultant.

B. Keying Conference: Conduct conference at Project site.
   1. Conference participants shall include Installer's Architectural Hardware Consultant.
   2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
      a. Flow of traffic and degree of security required.
      b. Preliminary key system schematic diagram.
      c. Requirements for key control system.
      d. Requirements for access control.
      e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
   2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
   3. Content: Include the following information:
      a. Identification number, location, hand, fire rating, size, and material of each door and frame.
      b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      d. Fastenings and other installation information.
      e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
      f. Mounting locations for door hardware.

C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing City's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Door Hardware: supply one extra of each type of lockset and deadbolt, two extra of each closer and door pull, and six extra of each type of hinge.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to City.

D. Deliver keys and permanent cores to City by registered mail or overnight package service.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of doors and door hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
      d. Locksets: Five years from Substantial Completion.
      e. Exit Devices: Two years from date of Substantial Completion.
      f. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and current California Building Code.
   1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
   2. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
   3. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
   1. Door hardware is scheduled in Part 3.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in door hardware schedule:
      a. Baldwin Hardware Corporation.
      b. Hager Companies.
      c. McKinney Products Company; an ASSA ABLOY Group company.
      d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
   1. Bored Locks: Minimum 1/2-inch latchbolt throw.
   2. Deadbolts: Minimum 1-inch bolt throw. Solid stainless steel bolt.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:
   1. Levers: Forged.
      a. Best Access Systems; Stanley Security Solutions, Inc; lever 14 with H rose.

E. Mortise Locks: BHMA A156.13; Operational Grade 1; Series 1000. Stamped steel case with steel or brass parts.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in door hardware schedule:
      a. Best Access Systems; Stanley Security Solutions, Inc. No substitutions.

2.5 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in door hardware schedule:
      a. Best Access Systems; Stanley Security Solutions, Inc. No substitutions.

B. Standard Lock Cylinders: BHMA A156.5; permanent cores; face finished to match lockset.
   1. Core Type: Removable.

2.6 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.
   1. Existing System:
      a. Master key or grand master key locks to City's existing system.

B. Keys:
   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
      a. Notation: Information to be furnished by City.

2.7 ACCESSORIES FOR PAIRS OF DOORS

A. Astragals: BHMA A156.22.

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Norton Series 7500 Series closer or comparable product by one of the following:
      a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
      b. DORMA Architectural Hardware; a division of DORMA Group North America.
      c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
      d. LCN a division of Allegion.

2.9 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Pemko Manufacturing Co. HSS2000xS88GR or comparable product by one of the following:
      a. Hager Companies.
      b. National Guard Products, Inc.
      c. Zero International, Inc.

2.10 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Pemko Manufacturing Co. 156A or comparable product by one of the following:

a. Hager Companies.
b. National Guard Products, Inc.
c. Zero International, Inc.

2.11 ROLLER CATCH

A. Roller Catch: BHMA A156.21; with adjustable roller latch and strike plate for each door leaf.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Baldwin 0440 Adjustable Roller Catch or comparable product by one of the following:
a. Ives.

2.12 METAL EDGE PROTECTIVE TRIM UNITS

A. Metal Edge Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Type 430, 16 Gauge stainless steel with No. 4 finish, and beveled mounting holes for stainless steel screws by InPro Corporation or comparable product by one of the following:
a. Allegion plc.
b. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
c. Trimco.

2.13 DOOR SWEEPS

A. Door Sweeps: with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Pemko Manufacturing Co. 18137DNB or comparable product by one of the following:
a. Hager Companies.
b. National Guard Products, Inc.
c. Zero International, Inc.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18. Supply ANSI/BHMI 626 or ANSI/BHMI 630 for locksets. ANSI/BHMI 626 for aluminum thresholds, seals, and weatherstripping. Push and pull handle and plates, and kick plate finishes are specified in door schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other 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 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches .

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as directed by City.
   2. Furnish permanent cores to City for installation.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide wall stops for doors unless floor or other type stops are indicated in door hardware schedule.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: City will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
   2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for City's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage Installer to train City's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 HARDWARE SCHEDULE

A. Provide hardware for each door to comply with requirements of this section, hardware set numbers indicated in door schedule; and in the following schedule of hardware sets.

HW-01 Building Entrance

Latch:	45H-7-A
Hinges:	As Specified
Closer:	As Specified
Stop:	As Specified
Door Gasket:	As Specified
Drip	As Specified
Threshold:	As Specified

HW-02 (Not Used)

HW-03 Passage

Roller Catch:	0440
Hinges:	As Specified

HW-04 Passage

Latch:	45H-0-N
Hinges:	As Specified
Closer:	As Specified
Stop:	As Specified
Door Gasket:	As Specified

HW-05 (Not Used)

HW-06 Privacy

Latch:	45H-0-L-VIN
Hinges:	As Specified
Closer:	As Specified
Stop:	As Specified

HW-07 Privacy

Latch:	45H-0-L
Hinges:	As Specified
Stop:	As Specified

END OF SECTION 08 71 00

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior gypsum board.
2. Tile backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

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 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.
   d. USG.
3. Core: 5/8 inch.
4. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by 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. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.
   d. USG.
3. Core: 5/8 inch .
4. Long Edges: Tapered.

C. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by 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. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.
   d. USG.
3. Core: 5/8 inch .
4. Long Edges: Tapered.
5. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by 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. C-Cure.
   b. CertainTeed Corporation.
   c. James Hardie Building Products, Inc.
   d. United States Gypsum Company.
3. Thickness: 1/2 inch .
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Paper-faced galvanized-steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Wallboard Type: Vertical surfaces unless otherwise indicated.
   2. Ceiling Type: Ceiling surfaces.
   3. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
   3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at shower walls and where indicated.

C. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations according to ASTM C 840 and in specific locations approved by City for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. Bullnose Bead: Use for matching existing outside corners at Fire Station #8.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 5: For all visible areas.

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. 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.

END OF SECTION 09 29 00

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Porcelain tile.
2. Stone thresholds.
3. Tile backing panels.
4. Waterproof membrane.
5. Metal edge strips.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain waterproof membrane anf crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Stone thresholds.
   2. Waterproof membrane.
   3. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Ceramic Tile Type CT-1: Unglazed porcelain tile for floors.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile City View or comparable product by one of the following:
      a. American Olean; a division of Dal-Tile Corporation.
      b. Crossville, Inc.
      c. Interceramic.
   3. Certification: Tile certified by the Porcelain Tile Certification Agency.
   4. Face Size Variation: Rectified.
   5. Face: Plain with square or cushion edges.
   6. Dynamic Coefficient of Friction: Not less than 0.42.
   7. Tile Size, Color, Glaze, and Pattern: 12” x 24”. Color will be selected by City from manufacturer’s standard offerings. Pattern is ½ tile offset in the longest direction of tile.
   8. Grout Color: Match tile color.
   9. Cove Tile: Supply at tile floor edges to wall. Match field tile color.

B. Ceramic Tile Type CT-2: Unglazed porcelain tile for floors.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Veranda Tones or comparable product by one of the following:
      a. American Olean; a division of Dal-Tile Corporation.
      b. Crossville, Inc.
      c. Interceramic.
   3. Certification: Tile certified by the Porcelain Tile Certification Agency.
   4. Face Size Variation: Rectified.
   5. Face: Plain with square or cushion edges.
   6. Dynamic Coefficient of Friction: Not less than 0.42.
   7. Tile Size, Color, Glaze, and Pattern: 6 ½” x 6 ½”. Color will be selected by City from manufacturer’s standard offerings.
   8. Grout Color: Match tile color.
   9. Cove Tile: Supply at tile floor edges to wall. Match field tile color.

C. Ceramic Tile Type CT-3: Unglazed porcelain tile for walls.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Veranda Solids or comparable product by one of the following:
      a. American Olean; a division of Dal-Tile Corporation.
      b. Crossville, Inc.
      c. Interceramic.
   3. Certification: Tile certified by the Porcelain Tile Certification Agency.
   4. Face Size Variation: Rectified.
   5. Face: Plain with square or cushion edges.
   6. Dynamic Coefficient of Friction: Not less than 0.42.
   7. Tile Size, Color, Glaze, and Pattern: 6 ½” x 13”. Color will be selected by City from manufacturer’s standard offerings.
   8. Grout Color: Match tile color.

2.4 THRESHOLDS

A. General: Fabricate stone to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

   1. Clorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Nobleseal TS, Noble Company (The) or comparable product by the following:
      a. Schuter Systems.
      b. Laticrete International.

2.6 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Fusion Pro Single Component Grout, Custom Building Products, Seal Beach, CA or comparable product by one of the following:
      a. Bonsal American, an Oldcastle company.
      b. C-Cure.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
   3. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

2.8 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter Systems L.P.; Schiene EV4A or comparable product by one of the following:
   a. Blanke Corporation.
   b. Ceramic Tool Company, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with City.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
      a. Tile floors in wet areas.
      b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Porcelain Tile: 3/16 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
2. Do not extend cleavage membrane under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 13

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish not less than 10 linear feet 200 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg For more than 95 deg F, in spaces to receive resilient products during the following time periods:
1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
   2. Flexco.
   3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
   1. Style and Location:
      a. Style B, Cove: Provide in areas with resilient flooring.

C. Thickness: 0.125 inch.

D. Height: 4 inches .

E. Lengths: Coils in manufacturer's standard length .

F. Outside Corners: premanufactured moulded wall base corners.

G. Inside Corners: Preformed premanufactured moulded wall base corners.

H. Colors: Color will be selected by City from manufacturer’s standard offerings.

2.3 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Johnsonite; A Tarkett Company.
   2. Roppe Corporation, USA.
   3. VPI, LLC, Floor Products Division.

B. Description: Rubber reducer strip for resilient flooring.

C. Profile and Dimensions: As indicated.

D. Locations: Provide rubber molding accessories in areas indicated.

E. Colors and Patterns: Color will be selected by City from manufacturer’s standard offerings.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
1. Adhesives shall have a VOC content of 50 g/L or less.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
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 manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by 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: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

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 resilient products until they are the same temperature as the space where they are to be installed.
   1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

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 practical 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. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes modular carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples for Initial Selection: For each type of carpet tile.
   1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.8 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, the following:
      a. More than 10 percent edge raveling, snags, and runs.
      b. Dimensional instability.
      c. Excess static discharge.
      d. Loss of tuft-bind strength.
      e. Loss of face fiber.
      f. Delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE - CPT-1

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Mindful Play 5T187 or comparable product by one of the following:
   1. Bentley Prince Street, Inc.
   2. Interface, LLC.
   3. Mannington Mills, Inc.
   4. Milliken & Company.

C. Color: As selected by Architect from manufacturer's full range.

D. Fiber Content: Solution Q Extreme nylon

E. Pile Characteristic: Level-loop pile.

F. Gauge: 1/10 inch.

G. Density: 10 per inch .

H. Pile Thickness: inches for finished carpet tile according to ASTM D 6859.

I. Surface Pile Weight: 16 oz./sq. yd..

J. Secondary Backing: Manufacturer's Eecoworx tile.

K. Backing System: synthetic.

L. Size: 24 by 24 inches .

M. Applied Treatments:
   1. Soil-Resistance Treatment: Manufacturer's standard treatment.
   2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
      a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
   1. VOC Content: Comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
   1. 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 F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
      c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Wood Subfloors: Verify the following:
   1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
   2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. Metal Subfloors: Verify the following:
   1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

F. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.
   1. Access Flooring Systems: Verify the following:
   2. Access floor substrate is compatible with carpet tile and adhesive if any.
   3. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch , protrusions more than 1/32 inch , and substances that may interfere with adhesive bond or show through surface.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. nstallation Method: As recommended in writing by carpet tile manufacturer .

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "CRI Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Concrete masonry units (CMUs).
   2. Cement Plaster.
   3. Steel and iron.
   4. Galvanized metal.
   5. Wood.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Products of Sherwin-Williams Co. are basis of design. Subject to compliance and City review, equivalent products by the following will be considered:
   1. Benjamin Moore & Co.
   2. Dunn-Edwards Corporation.
   3. Frazee Paint; Comex Group.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Nonflat Paints and Coatings: 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Masonry (Clay and CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. 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.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
   3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
   4. Paint entire exposed surface of window frames and sashes.
   5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work. Follow manufacturer's recommendation for given substrates:

1. Paint the following work where exposed to the exterior and view:
   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: City may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. CMU and Cement Plaster Substrates:
   1. Latex System: Dry film thickness of not less than 5 mils .
      a. Prime Coat: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300.
      b. Intermediate Coat: Same as topcoat.
      c. Topcoat: S-W A-100 Exterior Latex Flat A6 Series.
   2. Elastomeric System Alternate: Total dry film thickness of not less than 12 mils.
      a. Prime Coat: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300.
      b. Intermediate Coat: Same as topcoat.
      c. Topcoat: S-W Conflex, A5-400.

B. Steel and Iron Substrates:
   1. Latex System: Dry film thickness of not less than 5 mils .
      a. Prime Coat: S-W ProIndustrial Acrylic Metal Primer.
      b. Intermediate Coat: Same as topcoat.
      c. Topcoat: S-W Pro Industrial Acrylic Semigloss B66-650.

C. Galvanized Metal Substrates:
   1. Latex System: Dry film thickness of not less than 5 mils .
      a. Prime Coat: S-W ProIndustrial Acrylic Metal Primer.
      b. Intermediate Coat: Same as topcoat.
      c. Topcoat: : S-W Pro Industrial Acrylic Semigloss B66-650.

D. Wood Substrates:
   1. Latex System: Dry film thickness of not less than 5 mils .
      a. Prime Coat: S-W Durakote Latex Primer.
      b. Intermediate Coat: Same as topcoat.
      c. Topcoat: Latex, S-W A-100 Exterior Latex Satin, A82 Series.

END OF SECTION 09 91 13

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SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:
   1. Concrete masonry units (CMUs).
   2. Wood.
   3. Gypsum board.
   4. Plaster.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Benjamin Moore & Co.
   2. Dulux (formerly ICI Paints); a brand of AkzoNobel.
   3. Dunn-Edwards Corporation.
   4. Duron, Inc.
   5. Frazee Paint; Comex Group.
   6. Glidden Professional.
   7. PPG Architectural Finishes, Inc.
   8. Pratt & Lambert.
   9. Sherwin-Williams Company (The).

C. Products: Subject to compliance with requirements, provide product listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Nonflat Paints and Coatings: 50 g/L.

D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As indicated in a color schedule.
   1. Twenty percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Masonry (Clay and CMUs): 12 percent.
   2. Wood: 15 percent.
   3. Gypsum Board: 12 percent.
   4. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. 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.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   a.
2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   g. Other items as directed by the City.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: City may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:
1. Latex System :
   a. Block Filler: Block filler, latex, interior/exterior.
      1) S-W PrepRite ProBlock Primer, B51W00620, at 400 sq. ft. per gal.
   b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3).
   1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

B. Wood Substrates: Wood trim.
   1. Latex over Latex Sealer System:
      a. Prime Coat: Primer sealer, latex, interior.
         1) S-W PrepRite ProBlock Primer, B51W00620, at 400 sq. ft. per gal.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior (MPI Gloss Level 3).
         1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

C. Gypsum Board and Plaster Substrates:
   1. Latex over Latex Sealer System:
      a. Prime Coat: Primer sealer, latex, interior.
         1) S-W PrepRite ProBlock Primer, B51W00620, at 400 sq. ft. per gal.
      b. Intermediate Coat: Latex, interior, matching topcoat.
      c. Topcoat: Latex, interior (MPI Gloss Level 3).
         1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

END OF SECTION 09 91 23

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wall Mount Signs.

1.2 SUBMITTALS

A. Submit Shop Drawings to detail manufactured or fabricated items. Indicate materials, dimensions, finishes, and details of construction, including full size sections of typical members. Depict all fabrication joints, fasteners, and substrates.
1. Full Size Layout: Sign face, letter spacing, full text in correct font, edge or frame of sign.
2. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers
3. Camera-Ready Artwork: Submit full-size artwork or high quality photocopies artwork for approval. If copies are submitted, they must be suitable for judging sharpness of art and alignment.

B. Color/Finish Sample: Submit all colors specified: Two samples of each color on actual sign background material.
1. Full Size Sample: Provide one complete sign of each type to serve as comprehensive submittal showing color, material, layout, and construction.

1.3 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to this Project, with record of successful in-service performance, and sufficient production capacity to produce signs required without causing delay in Work.

B. Design Concept: Drawings indicate sizes, profiles, materials, images, arrangements, construction and dimensional requirements of signs.

C. Copy: Lettering shown on sign type Drawings is intended as guideline for layouts and type size only. All spelling and punctuation must be correct.
1. Materials: New stock, free from defects impairing strength, durability or appearance. All fabrication and installation in accordance with highest standards of trade. All signs and components free from visual and mechanical defects
2. Painted Surfaces and Other Applied Finishes: Smooth even finish free of marks, scratches dirt embedments, or wave irregularities
3. Align all letterforms to maintain a baseline parallel to sign format. Maintain margins as specified in sign type layouts
4. Replace all damaged sign surfaces and materials before Substantial Completion.

D. Produce smooth, level sign surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

1.4 REGULATORY REQUIREMENTS

A. ADA Compliance: All sign fabrication and installation must conform to most restrictive, recent and currently-in-force applicable sections of Americans with Disabilities Act (ADA) of 1990, Americans with Disabilities Act Accessibility Guidelines (ADAAG), publications of American National Standards Institute (ANSI), California Building Code, and International Building Code.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thickness indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with minimum allowable continuous service temperature of 176° F, and of the following general types:

1. Transparent Sheet: Where sheet material is indicated as clear, provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested according to the requirements of ASTM D 1003.
2. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes indicated.

B. Adhesives: Use in accordance with recommendations made by manufacturer of material to be laminated or adhered. Do not use adhesives that will fade, discolor, or delaminate as a result of ultraviolet light or heat.

C. Foam Tape: 1/16” thick.

D. Silicone Adhesive: Ready to use, high performance adhesive. General Electric GE 1200 sealant, translucent SCS 1201 or equal as recommended by manufacturer for bonding condition.

E. Adhesive Tape: Double-sided tape: 3M 467MP or approved equal, to be used for laminating tactile magnesium inserts to acrylic substrate.

F. Fasteners: Concealed fasteners fabricated from metals not corrosive to sign material and mounting surface. Do not penetrate sign-face surfaces during fabrication or installation of signs.

G. Fasteners: Resistant to oxidation or other corrosive action. Secure work with fasteners of same color and finish as components they secure, where exposed to view. Perform fabrication with fasteners in strict accordance with manufacturer’s specifications, directions, and recommendations, and as indicated on Shop Drawings.

H. Paints: Note exact identification of all paints on Shop Drawings and paint sample submittals. Provide paints that will not fade, discolor, or delaminate as a result of ultraviolet light or heat. Prime coats or other surface pretreatments, where recommended by manufacturer of paint, are required. Guarantee preparation, primer and finish coats for five (5) years against pitting, peeling, or fading. Apply all inks, paints, lacquers without pinholes, scratches, orange peeling, application marks, etc. For exterior signs, additional protective coating is required to assure color integrity and abrasion resistance.

2.2 FINISHES

A. Colors and Surfaces Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, as selected by City from manufacturer's standards.

B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

2.3 COPY

A. Typesetting: Submit full size patterns for review of letter form and spacing prior to fabrication. Type style as indicated on Drawings.

B. Raised Copy and/or Graphics: Raised with clean edges, 1/32 inch minimum. Remove all saw marks and chips prior to installation. Locate Braille copy below raised letter copy, with dots in color to match background.

C. Etched or Engraved Copy: Etch letters, numbers, symbols, and other graphic devices into sign panel on the face indicated to produce precisely formed copy, incised to uniform depth.

2.4 WALL MOUNT SIGNS

A. Basis of Design: Subject to compliance with Specifications, products by these manufacturers may be submitted:

1. ACE (acesign.com).
2. Advance (advancecorp.com).
3. APCO (apcosigns.com).
4. ASI-Modulex (asimodulex.com).
5. Best Sign Systems (bestsigns.com).
6. Bunting Graphics (buntinggraphics.com).
7. Innerface Sign Systems (innerfacesigns.com).
8. InPro (inprocorp.com).
9. Kroy Sign Systems (kroysignsystems.com).
10. Mohawk Sign Systems (mohawksign.com).

2.5 ACCESSORIES

A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to sign material and mounting surface.

B. Anchors and Inserts: Nonferrous metal or hot-dip galvanized anchors and inserts. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors.

PART 3 – EXECUTION

3.1 INSPECTION

A. General: Inspect project for physical conditions of each substrate or location to which signs will be attached. Notify City in writing of conditions unsatisfactory for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 SIGN CONSTRUCTION AND INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of type described and in compliance with manufacturer's instructions.
1. Coordinate anchor details and materials with City. Notify City in writing of all conditions detrimental to proper and timely installation of sign work.
2. Letter and Sign Fabrication: A complete system including all stiffeners, fasteners, welding, sealants, jointing, miscellaneous pieces and material thickness as required to form high quality workmanship. Connections, angles, shapes and details shown must be sized, reinforced and detailed as required.
3. Do not make changes in visual elements without City's prior review and written approval.

B. Installation:
1. Deliver materials to Project site in as large a fabrication as possible, protected from damage. Store in appropriate location away from heavy traffic before installation. Handle carefully to avoid damage. Scratched or dented materials will be rejected
2. Inspect all signs for evidence of damage before installation.
3. Examine conditions and substrates under which installation is to be performed and notify City in writing of all unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected or subsequent change of location has been indicated.
4. Follow all recommendations and instructions for installation as provided by manufacturer. Notify City in writing if such installation will not provide permanent, rigid installation in existing conditions.
5. Install sign units and components at locations shown, securely mounted with concealed, theft-proof fasteners. No exposed fasteners for installation may be visible. Attach signs to substrates in accordance with manufacturer's instructions. Provide anchorage and fittings. Coordinate location in field with City.
6. Install level and plumb at proper height. Repair or replace damaged units. Coordinate and field measure proper location of signs, where required, with City.
7. Coordinate with City all installation procedures and required scheduling, to avoid delays or additional costs.

8. Coordinate sign locations with existing mechanical, electrical, plumbing and landscape elements and notify City in writing of any visual or physical conflicts.
9. Protect all adjacent surfaces from damage during installation, promptly repair all such damage.
10. Adjust and clean sign surfaces so they are free of residue and other foreign materials. Following installation, remove all traces of visible tapes, adhesives, wrappings and refuse from Site.

C. Wall Mounted Signs: Attach signs to wall surfaces using methods indicated below:
1. Adhesives: All adhesives in accordance with recommendations made by manufacturer of material to be laminated or adhered. All visible joints free from air bubbles and other defects.
2. Foam tapes: 1/16" thick.
3. Silicone Adhesive: Ready to use, high performance adhesive. General Electric GE 1200 sealant, translucent SCS 1201 or approved equal as recommended by manufacturer for bonding condition.
4. Adhesive Tape: Hi-Performance double-sided adhesive tape, 3M 467MP, or approved equal, used for laminating tactile magnesium inserts to acrylic substrate.
5. Mechanical Attachment: At all irregular surfaces.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's instructions. Protect units from damage until acceptance by City.

B. Maintenance Instructions: Provide written instructions to City for proper maintenance of all signs. Address periodic cleaning, painting (include all color specifications) where applicable, replacement procedures, etc., in operation and maintenance manuals.

C. Provide written instructions for removal of signs from wall surfaces.

END OF SECTION 10 14 00

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SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Corner guards.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated.

D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
   2. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
      a. Store corner-guard covers in a vertical position.
      b. Store covers in a horizontal position.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

B. Fasteners: Nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened.

2.2 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed with formed edges; with 90- or 135-degree turn to match wall condition.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties Model CO-8 or comparable product by one of the following:
      a. Arden Architectural Specialties, Inc.
      b. Construction Specialties, Inc.
      c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
      d. Pawling Corporation.
   3. Material: Stainless steel,Type 304
      a. Thickness: Minimum 0.0625 inch.
      b. Finish: Directional satin, No. 4.
   4. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
   5. Corner Radius: 1/8 inch.
   6. Mounting: adherered.

2.3 FABRICATION

A. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

B. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Remove tool and die marks and stretch lines, or blend into finish.
   2. Grind and polish surfaces to produce uniform finish, free of cross scratches.

3. Run grain of directional finishes with long dimension of each piece.
4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

3.4 CLEANING

A. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

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SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Private-use bathroom accessories.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 CITY-FURNISHED MATERIALS

A. City-Furnished Contractor-Installed Materials: Soap dispenser.

2.2 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.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser TPH:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc B-6977 or comparable product by one of the following:
   a. American Specialties, Inc.; ASI Group.
   b. Bradley Corporation.
3. Mounting: Semirecessed Surface mount.
4. Capacity: Designed for two standard diameter tissue rolls up to 6" diameter.

C. Paper Towel (Folded) Dispenser PT:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-2620 or comparable product by one of the following:
   a. American Specialties, Inc.; ASI Group.
   b. Bradley Corporation.
3. Mounting: Semirecessed Surface mount.
4. Minimum Capacity: 400 C-fold or 525 multifold towels.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.
7. Refill Indicator: Pierced slots at sides or front.

D. Combination Towel (Folded) Dispenser/Waste Receptacle PTD/WR:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-3944 or comparable product by one of the following:
   a. American Specialties, Inc.; ASI Group.
   b. Bradley Corporation.
   c. Brey-Krause Manufacturing Co.
3. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
4. Mounting: Surface mounted.
   a. Designed for nominal 4-inch wall depth.
5. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
6. Minimum Waste-Receptacle Capacity: 12 gal.
7. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Grab Bar GB-1, GB-2, GB-3, and GB-4:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, In. B-5806 Series or comparable product by one of the following:
      a. American Specialties, Inc.; ASI Group.
      b. Bradley Corporation.
   3. Mounting: Flanges with fasteners.
   4. Material: Stainless steel, 0.05 inch thick.
      a. Finish: Smooth, No. 4 finish (satin) .
   5. Outside Diameter: 1-1/4 inches.
   6. Configuration and Length: Straight. GB-1 is 48 inches long, GB-2 and GB-3 is 36 inches long, and GB-4 is 24 inches long.

F. Sanitary-Napkin Disposal Unit SND:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-270 or comparable product by one of the following:
      a. Bradley Corporation.
      b. GAMCO Specialty Accessories; a division of Bobrick.
   3. Mounting: Surface-mounted.
   4. Door or Cover: Self-closing, disposal-opening cover.
   5. Receptacle: Removable.
   6. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Mirror Unit MR:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-165 2436 or comparable product by one of the following:
      a. American Specialties, Inc.; ASI Group.
      b. Bradley Corporation.
   3. Frame: Stainless-steel channel.
      a. Corners: Mitered and mechanically interlocked.
   4. Integral Shelf: 5 inches deep.
   5. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
      a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
      b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
   6. Size: 24 inches by 36 inches.

H. Robe Hook RH:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-76727 or comparable product by one of the following:

a. American Specialties, Inc.; ASI Group.
b. Bradley Corporation.

3. Description: Double-prong unit.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.

B. Shower Curtain Rod CR:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-207 x 60 or comparable product by one of the following:
a. American Specialties, Inc.; ASI Group.
b. Bradley Corporation.
c. Brey-Krause Manufacturing Co.
3. Description: 1-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
4. Mounting Flanges: Concealed mounting.
5. Finish: Stainless steel, No. 4 finish (satin).

C. Shower Curtain CR (Supply with curtain rod above):
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. 204-3 or comparable product by one of the following:
a. American Specialties, Inc.; ASI Group.
b. Bradley Corporation.
3. Size: Minimum 12 inches wider than opening by 72 inches high.
4. Material: Nylon-reinforced vinyl, minimum 10 oz. or 0.008-inch- thick vinyl, with integral antibacterial agent .
5. Color: White.
6. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
7. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

D. Soap Dish SD:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B4380 or comparable product by one of the following:
a. American Specialties, Inc.; ASI Group.
b. Bradley Corporation.
3. Description: Without washcloth bar.
4. Mounting: Recessed mounted.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 PRIVATE-USE BATHROOM ACCESSORIES

A. Source Limitations: Obtain private-use bathroom accessories from single source from single manufacturer.

B. Towel Bar TB:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-530 x 24 or comparable product by one of the following:
   a. American Specialties, Inc.; ASI Group.
   b. GAMCO Specialty Accessories; a division of Bobrick.
3. Description: 1-inch- round tube .
4. Mounting: Flanges with concealed fasteners.
5. Length: 24 inches.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Toiletry Shelf TS:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-295 x16 or comparable product by one of the following:
   a. American Specialties, Inc.; ASI Group.
   b. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
   c. GAMCO Specialty Accessories; a division of Bobrick.
3. Description: Surface-mounted, shelf with two mounting
4. Length: 18 inches.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.6 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 28 00

SECTION 10 28 19 - TUB AND SHOWER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes frameless shower doors and enclosures.

1.3 FIELD CONDITIONS

A. Verify dimensions by field measurements before fabrication and indicate on Shop Drawings.

PART 2 - PRODUCTS

2.1 FRAMELESS ENCLOSURES

A. Frameless glass panels with mounting and operating hardware of types and sizes required to support imposed loads.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product C.L Lawrence Co. Geneva Series or comparable product by one of the following:
      a. Agalite; Hartung Glass Industries.
      b. Alumax; Sapa Extrusions, Inc.
      c. Cardinal Shower Enclosures; Hoskin & Muir, Inc.
      d. Southeastern Aluminum Products, Inc.

B. Hardware and Trim: Manufacturer's standard units as indicated and as required for complete installation.
   1. Materials:
      a. Brass:
         1) Finish: Satin chrome.

C. Swinging Doors: Hinged for 90 degrees out swing. Self-centering when doors are within 15 degrees of closed position. Soft bulb seal or wipes; affixed to door to direct water back into enclosure and provide a tight water seal.
   1. Hinges: Side hinged.
   2. Door Pulls: Knobs.

D. Fixed Panels: Top-and-bottom mounts; match hinges in material and finish.

E. Glazing: Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
   1. Glass Nominal Thickness: 10 mm.
   2. Clear Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Kind FT.

3. Protective, Self-Cleaning, Glass Coating: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

F. Fasteners: Manufacturer's standard stainless-steel or other noncorrosive fasteners.

G. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare and install as recommended in manufacturer's written instructions unless more stringent requirements are contained in GANA's "Glazing Manual."

B. Clean substrates, removing projections, filling voids, and sealing joints.

C. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.

D. Fasten components securely in place, with provisions for thermal movement. Install with concealed fasteners unless otherwise indicated.

E. Install components to drain and return water to tub or shower.

F. Install doors to produce smooth operation and tight fit at contact points.

G. Repair, refinish, or replace components damaged during installation.

3.2 ADJUSTING AND CLEANING

A. Adjust operating parts and hardware for smooth, quiet operation and watertight closure. Lubricate hardware and moving parts.

B. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 10 28 19

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.
5. Solid surface material sinks.

1.3 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.4 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart 9113ML Meadow Melange or comparable product by one of the following:
a. Avonite Surfaces.
b. E. I. du Pont de Nemours and Company.
c. Formica Corporation.
d. LG Chemical, Ltd.
e. Samsung Chemical USA, Inc.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Grade: Custom .

B. Configuration:

1. Front: Beveled .
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch- thick, solid surface material.

D. Backsplashes: 3/4-inch- thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
1. Fabricate with loose backsplashes for field assembly.
2. Install integral sink bowls in countertops in the shop.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:
1. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.
1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
   1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
   2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
   1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61.16

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SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Piping Materials and Installation Common to Most Piping Systems.
2. Dielectric Unions and Flanges.
3. Escutcheons.
4. Mechanical Sleeve Seals.
5. Sleeves.
6. Motors and drives.
7. Combination Magnetic Starters.
8. Equipment Guards.
9. Equipment Installation Requirements Common to Equipment Sections.
10. Adjusting and Cleaning.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME).
1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.
3. ASME B16.20 - Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.
4. ASME B16.10 - Face to Face and End to End Dimensions of Valves.
5. ASME B16.34 - Valves Flanged, Threaded and Welding End.

B. National Certified Pipe Welding Bureau (NCPWB).

C. Standard Procedure Specifications

D. ASME SEC IX - ASME Boiler and Pressure Vessel Code - Section IX: Welding and Brazing Qualifications.

E. ANSI Standards.
1. ANSI B16.20 - Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.

F. AWWA Standards
1. AWWA C111/A21.11: Rubber-Gasket Joints for Ductile–Iron Pressure Pipe and Fittings

G. MSS Compliance:
1. MSS SP-25 - Marking System for Valves, Fittings, Flanges and Unions.
2. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service.
3. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
4. MSS SP-67 - Butterfly Valves.
5. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

6. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
7. MSS SP-78 - Gray Iron Plug Valves Flanged and Threaded Ends.
8. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.

H. FCI Compliance:
1. FCI 73-1 - Pressure Rating Standard for "Y" Type Strainers.
2. FCI 78-1 - Pressure Rating Standard for Pipeline Strainers other than "Y Type.

1.3 DEFINITIONS

A. "Piping" includes, in addition to pipe, all fittings, flanges, valves, hangers and other accessories related to such piping.

B. "Wiring" includes in addition to conductors, all raceway, conduit, fittings, boxes, switches, hangers and other accessories related to such wiring.

C. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings or embedded in construction.

D. "Exposed" means not installed underground or "concealed" as defined above.

E. "Provide" means to furnish and install.

1.4 SUBMITTALS

A. General
1. Comply with the requirements of Division 1 and the specific requirements of the Sections of Division 21.
2. Submit all similar equipment together as part of the same submittal. For example:
   a. All sprinklers must be contained in the same submittal.
   b. All hangers and supports must be contained in the same submittal.
3. Contractor must review all submittals prepared by each supplier and mark all copies as acceptable to the Contractor. This acceptance must signify that all required service connections are shown and in the proper location to meet the installation requirements and that the equipment can fit in the space allowed.
4. Do not order equipment until submittals have been reviewed and approved by the OWNER Representative.
5. Each item submitted must be labeled or identified the same as on the Drawings.
6. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what difference, if any, exists between the submitted item and the specified item. Failure to point out the differences will be considered cause for disapproval. The OWNER Representative will not assume any responsibility for differences concealed or otherwise not brought to their attention, and the Contractor will be required to correct any deficiencies or differences discovered at a later date, and assume responsibility for any delays, damage, and/or expenses incurred by others due to such action.
7. Brands or trade names are mentioned to set standards of quality only; use no substitute materials, however, unless approved in writing by the OWNER Representative. Approval of substitute materials does not relieve the Contractor of responsibility for providing a workable and functioning system as specified.
8. Submittals will be checked for general conformance with the design concept but acceptance by the OWNER Representative in no manner is meant to verify that

dimensions, quantities, or location of services are as necessary to meet the job requirements. This remains the responsibility of the Contractor.

B. Shop Drawings
   1. General: Prepare and submit plans, sections, details and diagrams to required scales for specified areas. Drawings must be coordinated, dimensioned and indicate equipment, piping, and ductwork in relation to architectural and structural features as well as other building systems. Include Minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers etc.
   2. Required Drawings: Prepare and submit drawings for all areas and all mechanical work. Scale must be minimum 3/8" = 1'-0" in mechanical rooms, fan rooms, and mechanical areas, and minimum 1/4" = 1'-0" elsewhere.

C. Coordination Drawings
   1. General: Coordination drawings are defined as "shop drawings" which also indicate, on the same drawings, the major utilities of all other trades. "Coordination Drawings" must indicate location and elevations of structural slabs and beams, architectural elements, domestic water piping, plumbing vents, sanitary drains, storm drains, fire protection piping, lighting fixtures, electrical conduits (2-inch and larger), ductwork, penetrations of walls and roof, fire dampers, fire/smoke dampers, automatic dampers, terminal boxes, air outlets, access panels, ceiling mounted equipment and controls, gas piping, flues, fans, air handling equipment, etc.
   2. Submit coordination drawings for the following:
      a. Entire building.
      b. Other areas for which space is limited.
   3. It is the intent of the coordination drawings to ensure coordination of all major utilities, prior to the start of installation. This is a substantial effort which will require careful and detailed coordination and planning to ensure appropriate information is available, from all trades, in a timely manner. The coordination drawing effort must be integrated into the project schedule and monitored to ensure conformance.
   4. Conflicts between trades, which cannot be resolved through generally accepted practice of coordination between trades, must be clouded on the coordination drawings and an appropriate description of the problem noted for review by the OWNER Representative.
   5. Nonconforming M/E work installed within designated coordination areas is subject to removal and replacement by installing contractor at no additional cost to Owner.
   6. Coordination drawings must be signed and dated by individual trade constrictors. By act of signature and submittal of singular combined coordination drawings, each trade contractor acknowledges coordination of their portion of the work with all other mechanical, electrical, architectural, and structural work contractors.

D. Product Data:
   1. General: Manufacturer's specifications, data sheets, certified drawings, and installation instructions. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, location and size of field connections, and accessories. Include certified drawings on major equipment such as boilers, water chillers, cooling towers, controls, pumps, and tanks.
   2. Include operating weight and location of center of gravity of each item of equipment in manufacturer's cut sheet for purposes of seismic calculation.
   3. Pipes and Pipe Fittings: Submit schedule showing pipe material data, sizes, fitting valve type k factor, working pressure for each service.

4. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.
5. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.
   a. Strainers: include pressure drop or chart for each type and size.
6. Meters and gauges: include scale range for each service.

E. Test Reports:
1. Manufacturer's Tests
   a. Factory Tests: As specified for specific equipment.
   b. Field Tests: As specified.
2. System Pressure Tests: As specified under "Testing" article. Test log of pressure tests on each system. Indicate date of test, scope of test, test pressure, duration, and observers.

F. Certification
1. Seismic Restraints: As specified under Section 21 05 29.
2. Welding Certificates.
3. Brazing Certificates.

G. Operating and Maintenance Manuals: Include, but not limited to, the following:
1. List of all equipment with Manufacturer's name, model number, and local representative, service facilities and normal channel of supply for each item. Include phone number and address of service facilities
2. Equipment: Manufacturer's brochures, ratings, certified shop drawings, lubrication charts and data, parts lists with part numbers, and belt and sheave data. Mark each sheet with equipment identification number and actual installed condition.
3. Materials and Accessories: Manufacturer's brochures parts list with part numbers and lubrication data where applicable. Mark each sheet with equipment identification number or system and location of installation; and to specifically identify which options are provided (in case where data sheet shows multiple options).
4. Certificate of factory tests, field tests and code compliance as specified.
5. Wiring and controls schematics.
6. Trouble shooting directions.
7. Maintenance procedures and frequencies.
8. Description of special tools.
9. Copies of warranties.
10. Safety precautions.
11. Emergency contingencies.

H. Record Documents
1. Comply with the Conditions of the Contract and the requirements of Division 1.
2. Indicate mains and branches of piping systems, with valves and control devices located and numbered per valve schedule, concealed unions located, and with items requiring maintenance located (i.e. traps, strainers, expansion compensators, vents, etc.). Indicate actual inverts and horizontal locations of underground piping.
3. Indicate equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Identify approved substitutions, Contract Modifications, and actual equipment and materials installed.

I. Samples: When specified under applicable Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Conform to the requirements specified in Division 1.

B. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

D. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.6 SUBSTITUTIONS

A. General:
1. Base manufacturer is indicated in equipment schedules.
2. In Specification, additional acceptable manufacturer(s) may be indicated.
3. Other manufacturers, materials, or methods must not be used unless approved in writing by the OWNER Representative.
4. The burden of proof as to the equality of any proposed substitute manufacturer, material**,** or method must be upon the Contractor.
5. The OWNER Representative's decision must be final.

B. Requests for substitution review and acceptance must be accomplished by table of comparison listing pertinent features of both specified and proposed materials, such as materials of construction, performance, dimensions, weights, replacement or maintenance access. Review of proposed substitutions will not be made until receipt of satisfactory comparison tabulation.

C. Submittal of substitutions must be limited to one proposal for each type or kind of item, unless otherwise permitted by the OWNER Representative. If first proposed product submittal is rejected, Contractor must then submit the first-named or scheduled product.

D. Contractor must be responsible for all costs and coordination due to the substitution, such as impacts on electrical requirements, weight, openings in slabs and roofs, structural framing, housekeeping pad size, etc.

1.7 JOB CONDITIONS

A. Cause as little interference or interruption of existing utilities and services as possible. Schedule Work which will cause interference or interruption in advance with Construction Manager.

B. Examine Contract Documents to determine how other Work will affect execution of mechanical Work.

C. Determine and verify locations of all existing utilities.

D. Arrange for, coordinate, and pay costs incidental to providing utility company services indicated.

E. Establish lines and levels for each system and coordinate with other systems to prevent conflicts and maintain proper clearances and accessibility.

PART 2 PRODUCTS

2.1 PIPE, TUBE AND FITTINGS

A. Refer to individual Division 21 piping sections for pipe, tube, fitting materials joining methods. Comply with governing regulations.

2.2 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Provide welding materials to comply with installation requirements.
   1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

2.3 PIPING SPECIALITIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service or, if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Dielectric Unions and Flanges:
   1. Refer to Division 21 water based fire suppression section for dielectric unions and flanges.

2.4 PIPE ESCUTCHEONS

A. Refer to individual Division 21 water based fire suppression sections for pipe escutcheons.

2.5 MECHANICAL SLEEVE SEALS

A. Refer to individual Division 21 water based fire suppression sections for pipe, tube, fitting materials joining methods. Comply with governing regulations.

2.6 FIRE BARRIER PENETRATION SEALS

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork.
   1. Refer to Division 21 water based fire suppression section for dielectric unions and flanges.

2.7 FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges:
   a. 3-inch and smaller: 0.040-inch/20 gauge thick.
   b. 4 to 6-inch: 0.064-inch/16 gauge thick.
   c. Over 6-inch: 0.079-inch/14 gauge thick.
2. Steel Pipe: See “Mechanical Sleeve Seals” article.

2.8 EQUIPMENT GUARDS

A. Use suitable structural frames with minimum 12-gauge, 3/4-inch galvanized mesh, or expanded metal mesh.

B. Attach to equipment by removable clips and bolts with swing nuts, or other approved connectors.

C. At belts, provide opening for measuring RPM’s.

D. Provide at all belts, couplings, moving machinery and equipment in accord with OSHA.

E. Design for easy access to belts and other items requiring replacement.

F. Provide holes in guards for tachometer readings and checking of belt tension.

G. Install in least obstructive manner as possible, with respect to equipment operation. For example, keep fan drive guards as far out of inlet air stream as practical, so as to minimize effect losses.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2 inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1 inch clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall

construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

D. Electrical and Elevator Equipment Spaces: Do not run piping or ductwork through transformer vaults, electrical rooms and other electrical or electronic equipment spaces and enclosures, unless piping or ductwork is for equipment serving that electrical space.

E. Comply with ASME B31.1.

F. Pressures: Do not install piping, valves or piping specialties where exposed to system pressures greater than their rated working pressures.

G. Sloping, Air Venting and Draining:
1. Slope piping as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in direction of flow as follows:

H. Install piping free of sags and bends. Support requirements are specified in Section 23 05 29.

I. Refrigerant: Clean, dehydrate, and cap refrigerant piping. Take care to ensure that entire system is clean and dry during installation. Clean tubing by means of swab saturated in methyl alcohol or refrigerant 12 drawn through tubing as many times as necessary to thoroughly clean and dry interior of tubing and to eliminate formation of copper oxide. Before refrigerant lines are silver brazed, flush all air from tubing and pass slow-running stream of dry nitrogen through system during brazing process. Purge lines completely and maintain nitrogen flow at steady rate of not less than three cubic feet per hour. After brazing, interior of refrigerant lines must be clean and bright.

J. Fittings:
1. Provide standard, manufactured fittings in all cases. Field fabricated fittings are prohibited. Bushings are prohibited on pressure piping.
2. Weld-O-Lets and Thread-O-Lets may be used for non-galvanized steel piping if main pipe size is at least three standard pipe sizes larger than branch pipe, e.g. 2-inch main and 1-inch branch.
3. Provide insulating couplings at connections of ferrous piping to non-ferrous piping.

3.2 INSTALLATION OF VALVES

A. General: Except as otherwise indicated, comply with the following requirements:
1. Install valves where required for proper operation and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

D. Fluid Control: Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ASME B31.9. Where throttling is indicated or recognized as principal reason for valve, install globe valves.

E. Installation of Check Valves:
   1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.
   2. Wafer Check Valves: Install between two flanges in horizontal or vertical position, position for proper direction of flow. Provide silent type wafer check valves at pump discharge locations.
   3. Lift Check Valve: Install in piping line with stem vertically upward, position for proper direction of flow.

F. Install globe valves to close against pressure.

G. Install plug valve with seat toward equipment to be isolated.

H. Valve Discharge Piping: Provide discharge pipe to atmosphere from all relief and safety valves, sized with area equal to sum of outlet areas of all valves connected thereto, unless indicated larger.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surfaces.

B. Dielectric Unions and Flanges: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

C. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

D. Fire Barrier Penetration Seals: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

3.4 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs.
   1. Do not install sleeves through structural members, except as detailed on Drawings, or as reviewed by the OWNER Representative.
   2. Install sleeves accurately centered on pipe runs.
   3. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run.

4. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation.
5. Pack 100 percent of annular space between sleeve and pipe or pipe insulation. Provide acoustical sealant at each end of pipe sleeve to seal packing in place.
   a. At fire-rated walls, partitions, floors, roofs, and ceilings: Packing must be through-penetration firestop.
   b. At non-fire-rated walls, partitions, floors, roofs, and ceilings: Packing must be fiberglass insulation, with density of 1.5 pcf.
6. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves.
7. Extend floor sleeves 1 inch above level floor finish.
8. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
9. Provide temporary closure to prevent concrete and other materials from entering sleeves.

B. Type of Sleeves
1. Install sheet-metal sleeves at walls and partitions.
2. Install schedule 40 pipe sleeves in concrete slabs.
3. Install mechanical sleeve seals at exterior penetrations; below grade, and at slabs-on-grade.

C. Mechanical Sleeve Seals: Install in accordance with the manufacture's instructions.

3.5 PIPING EXPANSION PROVISIONS

A. General: Install domestic hot water piping with at least 4 elbows or tees at following locations.
1. Between piping mains and risers.
2. Between equipment and pump or tank.
3. Between piping main and equipment.

B. Expansion Loops: Fabricate expansion loops as indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Provide pipe anchor and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.
1. At Contractor's option, pipe anchors may be insulated lugged anchors; Pipe Shields, Inc., Model #C4000 Series. Comply with requirements for insulated pipe supports in Section 23 05 29.
2. At Contractor's option, pipe guides may be guided insulated pipe supports; Pipe Shields, Inc., Model #B3000 or B7000 Series. Comply with requirements for insulated pipe supports in Section 23 05 29.

3.6 TESTING

A. General: Provide labor and test equipment including test pumps, gauges, instruments and other equipment required. Use test quality pressure gauges, instruments and other equipment required. Use test quality pressure gauges with range of approximately twice test pressure. Use calibrated gauges and instruments.

B. Piping:
1. General: Remove from systems, during testing, equipment which would be damaged by test pressure. Replace removed equipment after testing. Systems may be tested in

sections as work progresses; however, any previously tested portion must become a part of any later test of composite system.

2. Correct leaks by remaking joints with new material; makeshift remedies will not be permitted. Test time accrues only while full test pressure is on system. Test before backfilling, concealing, insulating or making connections to potable water system.
3. Test Schedule: Test each section of systems at one and one-half times the maximum working pressure of that section, but at not less than scheduled test pressure. Obtain maximum working pressures from the OWNER Representative if not indicated on Drawings. Unless indicated otherwise, scheduled tolerance is “no pressure loss”, except that due to temperature change, in 24 hour period.

C. Valves:
1. General Service Valves: Test bonnets for tightness. Test operate from closed-to-open-to-closed position while under test pressure.
2. Automatic Valves: Test, including solenoid valves, water regulating valves, pressure reducing valves, pressure relief valves, safety valves and temperature and pressure relief valves for proper operation at settings indicated.
3. Safety Valves: Test relief valves, safety relief valves, safety valves and temperature and pressure relief valves 3 times.

D. Piping Specialties: Test thermometers, pressure gauges, flow measuring devices, and water meters for accurate indication; automatic water feeders, air vents, trap primers, vacuum breakers, and other specialties for proper performance.

E. Hangers and Supports: With systems in normal operation, test hangers, supports and rods to insure they are plumb and supporting proper share of load. Additionally support systems and equipment that sway, crawl, or vibrate.

F. Ductwork: Comply with the requirements of Section 23 31 00.

G. Ductwork Specialties:
1. Verify fire dampers, fire/smoke dampers, smoke dampers, and two position AVD’s (automatic volume dampers) are 100% open, unless damper is indicated to be closed during normal operation.

H. Buried Pipe and Equipment Wrapping and Coating: Test surfaces with standard 8,000 to 10,000 volt electrical holiday detector.

I. Other Materials and Equipment:
1. Rotation: Verify.
2. Motor Amperage: Verify operating motor amperage does not exceed motor nameplate rating.
3. Test as specified; as recommended by equipment manufacturer; and as otherwise necessary or directed to assure they are complete, operable, and ready for use.

3.7 ADJUSTING AND CLEANING

A. Inspect all equipment and put in good working order.

B. Clean all exposed and concealed items:
1. Clean air surfaces of all coils, fans (including fan wheels and motors), air handler plenums and air filter frames.

2. Clean floor drains, cleanouts, and plumbing fixtures.
3. Clean specialties such as traps and strainers. Replace strainer screens with new prior to system commissioning.

C. Ductwork: Blow-out ducts with fans before connecting terminal units. Clean ducts before installing air outlets.

D. Equipment and Materials: Remove foreign materials including dirt, grease, splashed paint, and plaster, etc. Restore damaged finishes to original condition.

E. Piping: Flush clean interior of piping. Upon completion of flushing, completely drain systems at low points; remove, clean, and replace strainer baskets and refill systems.

F. Gas: After testing of natural gas system, and before any gas is put into line, blow out entire system of piping to remove scale and dirt; purge air by filling system with gas.

G. Adjusting: Adjust equipment and system components as indicated or as otherwise required to result in intended system operation. Thereafter, as a result of system operation, or as directed, make readjustments as necessary to refine performance and to effect complete system tune-up.

3.8 SPECIAL TOOLS

A. Furnish to Owner not later than when OWNER takes possession of equipment.

B. Definition of Special Tools: Identified in or otherwise implied by, the manufacturer's operation and maintenance manuals for the furnished equipment, or which are otherwise required for the operation, with the manufacturer's recommended procedures for operation, adjustment and maintenance. Special tools do not include those required for major repairs normally done by factory trained or otherwise specialized service personnel, nor do they include those normally found in the possession of OWNER's on site maintenance personnel.

3.9 MANUFACTURER'S START-UP ASSISTANCE

A. Where the services of a factory authorized service representative are specified for the start-up of certain pieces of equipment, arrange to have the manufacturer of such equipment perform start-up and check-out service. Manufacturer must provide a letter which must be on the manufacturer's letterhead, must list the equipment, must certify that the equipment has been examined, that it has been installed in accordance with the manufacturer's installation instructions, started up, adjusted, and checked out in accordance with the manufacturer's instructions, and is operating properly. The letter must be addressed to the OWNER and must be signed by an authorized representative of the manufacturer.

3.10 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush clean interior of piping. Inspect each run of each system for completion of joints, supports and accessory items. Upon completion of flushing, completely drain systems at low points; remove, clean and replace strainer baskets and refill systems.
   1. Inspect pressure piping in accordance with procedures of ASME B31.

3.11 ADJUSTING AND CLEANING OF VALVES

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Valve Identification: Tag each valve in accordance with Section 23 05 53.

3.12 ADJUSTING AND CLEANING OF PIPING SPECIALTIES

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.13 EQUIPMENT VIBRATION

A. Mechanical Balance: Fans, pumps, motors, and drives, when equipment is installed and in normal operation, must be within the following maximum limits, unless specified more restrictively for individual equipment items:
   1. 600 RPM and Less: 0.003-inch displacement, peak-to-peak.
   2. Over 600 RPM: 0.10-inch per second velocity, peak.

B. Pulley Run-Out: When equipment is installed and in normal operation, pulley run-out in radial and axial directions not to exceed 0.001-inch.

C. Field Tests: If requested, test equipment to determine compliance with specified requirements. Measure vibration displacement and velocity in vertical direction relative to floor. Make measurements on bearing housings (not end caps), or other heavy structural element directly connected to bearing housing, at each end of equipment.

D. Field Balancing: Balance and retest equipment as required for compliance with specified requirements.

END OF SECTION

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21 05 29 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe Hangers and Supports.
2. Vertical Piping Clamps.
3. Hanger-Rod Attachments.
4. Building Attachments.
5. Pipe Shields.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP 90, Guidelines on Terminology for pipe hangers and supports.

1.3 QUALITY ASSURANCE

A. Manufacturer's qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards
1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. Qualify welding processes and welding operators according to AWS D1.1, Structural Welding Code-Steel.
   a. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
3. Qualify welding processes and welding operators according to ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications.
4. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
   a. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems
   b. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
5. Licensed Engineer: Prepare hanger and support design drawings and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Structural Engineer licensed in the State of California certifying compliance with Specifications.
6. MSS Standard Compliance:
   a. Provide pipe hangers and supports of which materials design and manufacture comply with MSS SP-58. Select and apply pipe hangers and supports, complying with MSS SP-69.
   b. Fabricate and install pipe Local and supports, complying with MSS SP-89.
   c. Terminology used in this Section is defined in MSS SP-90.

C. Corrosion Resistance: Provide hot-dip galvanized steel, cadmium plating, or other approved corrosion resistant materials for exterior work and for work which will be subject to outdoor exposure during construction.

D. Coordination
   1. Coordinate resiliently supported work with other trades to avoid rigid contact with the building. Inform other trades such as drywall, plastering, or electrical, to avoid any contact which would reduce the vibration isolation.

E. Conflicts and Discrepancies
   1. Bring to the OWNER Representative's attention prior to installation any conflicts with other trades which will result in unavoidable contact to equipment, piping, etc., described herein, due to inadequate spaces, etc. Corrective work necessitated by conflicts after installation must be at Contractor's expense.
   2. Bring to the OWNER Representative's attention prior to installation any discrepancies between the Specifications and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective work necessitated by discrepancies after installation must be at Contractor's expense.

F. Inspection and Instruction
   1. Obtain inspection and approval from the OWNER Representative of any installation to be covered or enclosed prior to such enclosure.

1.4 VIBRATION ISOLATION

A. Comply with the requirements of Section 21 05 48.

1.5 SEISMIC RESTRAINTS

A. Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Include the following:
   1. Manufacturer's data (catalog cuts and data sheets), for each manufactured component including hangers, attachments, inserts, thermal shields anchors and guides, auxiliary framing and wall seals. Provide a project specific hanger and support schedule indicating all devices, manufacture and model, where used. Cross reference to product data and specification paragraph. Data must demonstrate that components comply with Specifications.
   2. Support and Bracing Shop Drawings: Submit plans, sections, details, schedules and other information necessary to describe support hangers for all HVAC systems. Submittal must indicate location and type of all hangers and supports. Each attachment to the building structure must have vertical and horizontal point loads identified.
   3. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual in accordance with requirements of Division 1.
   4. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
   5. Shop drawings for each type of hanger and support, indicating dimensions weights, required clearances, and methods of component assembly.
   6. Licensed Engineers hanger and support drawings specified in the "Quality Assurance' Article

7. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

PART 2 PRODUCTS

2.1 GENERAL

A. Where not fully called for in the Contract Documents, design of HVAC hangers and supports must be the Mechanical Contractor's responsibility. Design must conform to accepted engineering practice using a safety factor of 2-1/2.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
   1. Superstrut, Gold Galv.
   2. B -Line Systems, lnc.
   3. Elcen Metal Products Co.
   4. Fee & Mason Mfg.Co.; Div. Figgie International ITT Grinnel Corp.
   5. Hubbard Enterprises / HOLDRITE.
   6. Tolco.

2.3 MANUFACTURED HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide felt-lined hangers and supports for copper piping systems in direct contact with copper piping components including galvanized coatings where installed for piping and equipment that will not have a field applied finish. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper piping.

B. Thermal-Hanger Shield Inserts: 100 psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Shield Insert must cover entire circumference of pipe and be of length indicated by manufacturer for pipe size and thickness of insulation by CSS Pre-Insulated Supports.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated type, drive-pin attachments are not acceptable.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Adjustable Steel Clevises Hangers: MSS Type 1.

F. Yoke Type Pipe Clamps: MSS Type 2.

G. Steel Double Bolt Pipe Clamps: MSS Type 3.

H. Steel Pipe Clamps: MSS Type 4.

I. Pipe Hangers: MSS Type 5.

J. Adjustable Swivel Pipe Rings: MSS Type 6.

K. Adjustable Steel Bond Hangers: MSS Type 7.

L. Adjustable Band Hangers: MSS Type 9.

M. Adjustable Swivel Rings, Band Type: MSS Type 10.

N. Split Pipe Pings: MSS Type 11.

O. Extension Split Pipe Clamps: MSS Type 12.

P. U-Bolts: MSS Type 24.

Q. Clips: MSS Type 26.

R. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
1. Plate: Unguided type.
2. Plate: Guide type.
3. Plate: Hold-down Clamp type.

S. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange.

T. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

U. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.

V. Single Pipe Rolls: MSS Type 41.

W. Adjustable Roller Hangers: MSS Type 43.

X. Pipe Roll Stands: MSS Type 44.

Y. Pipe Rolls and Plates: MSS Type 45.

Z. Adjustable Pipe Roll Stands: MSS Type 46.

AA. Makeshift, field devised methods of HVAC pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping must be by means of engineered methods that comply with IAPMO PS 42.

2.4 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical piping clamps complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published

product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide felt-lined or copper-plated clams for copper-piping systems.

B. For vertical mid-span supports of piping 4-inch and under, use Hubbard Enterprises/HOLDRITE Stout Brackets with Hubbard Enterprises/HOLDRITE Stout Clamps or two-hole pipe clamps (MSS Type 26).

C. Two-Bolt Riser Clamps: MSS Type 8.

D. Four-Bolt Riser Clamps: MSS Type 42.

2.5 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.6 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Powder-actuated fasteners are not acceptable.

B. Concrete Inserts
   1. Cast-in-Place Concrete Inserts: MSS Type 18.
   2. Post-Installed Anchors: Proprietary type, designed for intended uses, and ICC ESR evaluated.
      a. Manufacturers
         1) ITW Ramset/Red Head.
         2) Simpson.
         3) Hilti Co.

C. Top Beam C-Clamp: MSS Type 19.

D. Side Beam or Channel Clamps: MSS Type 20.

E. Center Beam Clamps: MSS Type 21.

F. Welded Beam Attachments: MSS Type 22.

G. C-Clamps: MS Type 23.

H. Top Beam Clamps: MSS Type 25.

I. Side Beam Clamps: MSS Type 27.

J. Steel Beam Clamps with Eye Nut: MSS Type 28.

K. Linked Steel Clamps with Eye Nut: MSS Type 29.

L. Malleable Beam Clamps: MSS Type 30.

M. Steel Brackets: One of the following for indicated loading:
   1. Light Duty: MSS Type 31.
   2. Medium Duty: MSS Type 32.
   3. Heavy Duty: MSS Type 33.

N. Side Beam Brackets: MSS Type 34.

O. Plate Lugs: MSS Type 57.

P. Horizontal Travelers: MSS Type 58.

Q. Powder-Actuated Fasteners: Not allowed.

2.7 INSULATED PIPE SUPPORTS (PIPE SHIELDS)

A. All insulated lines must be protected at the point of support by insulated pipe supports provided and installed by the pipe erector.

B. All insulated pipe supports must be load rated. Load ratings must be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes:
   1. ASME B31.1, MSS SP-58, MSS SP-69, and MSS SP-89.

C. Manufacturer: Pipe Shields Incorporated (PSI); Michigan; B-Line.

D. Insulated Pipe Supports
   1. Pipe supported on rod hangers PSI, Michigan, B-Line.
   2. Pipe supported on Flat Surfaces PSI, Michigan, B-Line.
   3. Pipe supported on pipe rolls PSI, Michigan, B-Line,
   4. Pipe Guides PSI, Michigan, B-Line.
   5. Anchors PSI, Michigan, B-Line.
   6. Riser Pipe Supports PSI, Michigan, B-Line.

E. Insulation
   1. 360-degrees insulation, encased in 360-degrees sheet metal shield.
   2. Provide assembly of same thickness as adjoining pipe insulation.
   3. Insulating Material:
      a. Cold Piping (below 50 degrees F): Urethane foam, 100 psi compressive strength.
      b. Hot piping (above 50-degrees F): Calcium silicate, 100 psi compressive strength, treated with water repellent.

2.8 MISCELLANEOUS MATERIALS

A. Auxiliary Steel:
   1. Provide auxiliary structural steel as required for supports, anchors, guides, seismic restraints and vibration isolators.
   2. All structural steel systems to be designed in accordance with AISC Steel Handbook.
   3. All systems to be secured to building structure in a method acceptable to and approved by the Project Structural Engineer.
   4. Steel Work: Fabricate neatly. Grind off excess burrs and welding spatter. Paint with rust inhibitive primer.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A36.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No.2). Mix at a ratio of 1.0 part cement to 2.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS Standards.

E. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
   1. Manufacturers
      a. Hyspan.
      b. Metraflex.

F. Plenum Rated Pipe Clamps: ASTM E84 25/50 plastic clamps from Hubbard Enterprises/Holdrite.

PART 3 EXECUTION

3.1 GENERAL

A. Install devices in accordance with manufacturer’s recommendations.

B. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

C. Support of pipe tubing and equipment must be accomplished through means of engineered products specific to each application. Makeshift field devised methods will not be allowed.

D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the Work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated Work, Installer must meet at Project site with Contractor, Installer of each component of associated Work, Inspection and testing agency representatives (if any), Installers of other Work requiring coordination with Work of this Section and the OWNER Representative for purpose of reviewing material selections and procedures to be followed in performing the Work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

B. Loading on Steel Beams
   1. Do not place eccentric loads on steel beams for loads greater than 50-pounds.
   2. For loads greater than 50 pounds, use attachments which create concentric loading.

C. Cast-in Place Concrete Inserts
   1. Install before concrete is placed. Fasten inserts securely to forms.
   2. Install with reinforcing bar through opening at top of insert or with steel plate to distribute load, as detailed on Drawings.
   3. Maximum load per insert in slabs must be 200 pounds, with a minimum spacing of 5 feet in any direction. For loads greater than 200 pounds, or where spacing cannot be maintained, make attachment to building structure or auxiliary steel, rather than to slab.

D. Concrete Wedge Anchor Inserts: Maximum tension load per insert must not exceed manufacturer's published rating.

E. Powder-Actuated Fasteners: Not allowed.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports of smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Install in accordance with Seismic Restraint manual Guidelines for Mechanical Systems (SMACNA).
   1. Materials, design and type numbers per MSS-58.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, felt-lined.

D. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.1 Power Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements:
1. Provide insulated pipe support (pipe shield) at each support of insulated piping.
2. Select model of insulated pipe support according to published recommendations of insulated pipe support manufacturer, based on pipe size, pipe material, fluid medium, fluid temperature, support spacing, and type of support.
3. Submit tabulation showing proposed uses of insulated pipe supports for different applications.

H. Provide pipe supports on all DWV vertical piping penetrating floor slabs.

I. All hanger components must be Superstrut Gold Galv.
1. Vertical Piping: Superstrut clamps attached to the pipe above each floor to rest on the floor. Provide copperplate on copper tubing. Provide additional support at base of cast iron risers. Provide intermediate support for vertical piping greater than 12 feet in length.
2. Individually Suspended Piping: Superstrut complete with threaded rod. All hangers on supply and return piping handling heating hot water or steam must have a swing connector at point of support. Copper pipe will be used in conjunction with felt lined hangers.

Pipe Size	Rod Size
2-inch and Smaller	3/8-inch
2-1/2-inch to 3-1/2-inch	1/2-inch
4-inch to 5-inch	5/8-inch
6-inch	3/4-inch
8-inch and up	7/8-inch

3. Provide 3/8 inch or support of PVC and CPVC and provide continuous support.
4. Trapeze Suspension: Superstrut 1-5/8-inch width channel in accordance with manufacturer's published load ratings. No deflection to exceed L/180 of a span.
5. Trapeze Supporting Rods: Must have a safety factor of 5; securely anchor to building structure.
6. Pipe Straps: Superstrut 702 isolate copper pipe with two thicknesses of 2-inch wide 10-mil polyvinyl tape (Cush-A-Strip or Cush-A-Clamps). Where used for seismic support systems, provide Superstrut 702 or C708 series pipe straps.

J. Concrete Inserts: Superstrut C302 continuous insert or 452-TB spot insert. Do not use powder-actuated fasteners for support of overhead piping unless approved by the OWNER Representative.
   1. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
   2. Install concrete inserts in new construction prior to placing concrete. Superstrut 452-TB, C745, or C302.
   3. Install post-installed concrete anchors after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

K. Steel Connectors: Beam clamps with retainers.
   1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts washers, and other accessories

L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

M. Support to Structure
   1. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the OWNER Representative.

N. Rubber Neoprene Pipe Isolators
   1. Pipe isolators must comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Architectural Drawings must show location of acoustical walls.
   2. Isolation material must be either a rubber or neoprene material that prevents contact between the pipe and the structure. Superstrut S716 or A716.

O. Pipe Hangers and Support Spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and space at or within following maximum limits. Note that spacing listed are recommended maximums; increased spacing requirements due to California Building Code requirements, CCR Title 24, or other regulations in force and applicable for this contract must be adhered to.

Pipe Diameter	Steel Fluid	Steel Vapor	Copper Fluid
1/2 to 1-inch	6	8	6
1-1/4 to1-1/2-inch	8	10	6
Over 2-inch	10	10	10

P. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

Q. Provide rigid insulation and a 12-inch long, 18 gauge galvanized sheet metal shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering or CSS Pre-Insulated Calcium Silicate Support.

R. Insulate copper tubing from ferrous materials and hangers with felt lined hangers.

S. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

T. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power-actuated fasteners will not be allowed.

3.5 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint and exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA1 requirements for touching up field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Structural Engineer, licensed in the State of California, certifying compliance with Specifications.

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SECTION 21 05 48 – VIBRATION AND SEISMIC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vibration Isolators.
2. Seismic Restraints.
3. Flexible Connectors.

1.2 REFERENCES

A. ASHRAE - Guide to Average Noise Criteria Curves.

B. SMACNA “Guidelines for Seismic Restraints of Mechanical Systems”.

1.3 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. All items of a given type must be the product of the same manufacturer.

C. Provide necessary design for avoidance of excessive noise and vibration in building due to operation of machinery or equipment, or due to interconnected piping or conduit.

D. Installation of all vibration isolation units, and associated hangers and bases, must be under direct supervision of vibration isolation manufacturer’s representative.

1.4 REGULATORY REQUIREMENTS

A. Provide seismic restraints for pipes and equipment, including pipes above roofs, supported from below in accordance with the requirements of the California Code of Regulations, Title 24, Parts 3, 4, and 5.

1.5 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop drawings and product data; submittal must include:
1. Concrete and steel details for equipment.
2. Vibration isolation devices: Catalog cuts, isolation efficiencies and rated static deflections.
3. Welds or anchor bolt locations.
4. Reinforcing and template steels.
5. Number and locations of seismic restraints for each piece of equipment; specific details of restraints including anchor bolts for mountings and maximum load at each location.
6. Spring O.D., free operation, and solid height of springs and ratio of horizontal to vertical stiffness.

7. Number and location of vibration isolators for each piece of equipment including actual operating load for each vibration isolator.

C. Seismic calculations for each seismic restraint sized and signed by registered Structural Engineer licensed in the State of California.

D. Manufacturer's installation instructions.

E. Manufacturer's Installation Report as specified in the "Field Quality Control" Article.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers
1. Mason Industries, Inc.
2. Vibration Mountings and Controls, Inc.
3. Vibration Eliminator Company.
4. Peabody Noise Control, Inc.

B. Manufactured Units.
1. Isolator Type "PN"; three layers of 1/4-inch neoprene waffle pad bounded between 16 gauge sheet metal shims or 3/4-inch thick neoprene waffle pad consisting of 2-inch square modules separated by thin web. Load distribution top plate utilized as required with additional 1/5 inch thick washer and bushing when pads are anchored to structure.
2. Isolator Type "NM": Double deflection neoprene mountings having a minimum static deflection of .35 inch. Metal surfaces neoprene covered to avoid corrosion. Friction pads top and bottom.
3. Isolator Type "NML": Neoprene mountings with integral seismic restraints and consisting of captive steel insert embedded in neoprene. Mountings may be used in tension and shear as well as compression. Neoprene pad may be bonded to base plate for additional deflection as required.
4. Isolator Type "MS": Spring type, free standing and laterally stable without any housing, complete with 1/4-inch neoprene acoustical friction pad or neoprene cup between base plate and support. Provide leveling height and solid spring height in submittals.
5. Isolator Type "MSL": Spring type mountings designed to resiliently resist seismic forces in all directions. Snubbing in all modes with adjustment to limit upward, downward and horizontal travel to a maximum of 1/4 inch before contacting snubbers. Provide spring with same characteristics as described in Type MS mountings. Provide mountings with leveling bolts that must be rigidly bolted to equipment, and with ports or openings to verify possible overload conditions. In submittals include spring diameter, deflections, compressed spring height and solid spring height.
6. Isolator Type "HN": Vibration hangers which contain minimum .35-inch static deflection neoprene element. Neoprene rod isolation bushing must pass through hanger box lower hole to prevent metal to metal contact.
7. Isolator Type "HS": Vibration hangers which contain steel spring seated in 1/4-inch thick neoprene cup with integral rod isolation bushing. Bushing must pass through lower hanger box hole to prevent metal-to-metal contact. Provide spring diameters and hanger box lower hole sizes large enough to permit hanger rod to swing through 30 degree arc. Provide minimum additional travel to solid equal to 50 percent of rated deflection.

2.2 SEISMIC RESTRAINTS

A. Manufacturers
1. Midland-Ross Superstrut.
2. Pipe Shields, Inc.
3. B-Line.

B. Restraint Types
1. Type R-1: Provide directional seismic restraints with interlocking steel members restrained by replaceable, minimum 1/4-inch thick bridge bearing neoprene bushing, capable of rotation after installation to verify isolation system is out of contact with restraints. Incorporate minimum air gap of 1/8 inch in snubber design in all directions before contact is made between rigid and resilient surfaces.
2. Type R-2: Restraints of all isolated suspended piping, ductwork and equipment using steel cables arranged to achieve required all-directional restraint and sized to resist seismic loads. Indicate proposed method of achieving sufficient slack to avoid short circuiting vibration isolators in submittal drawing.

C. General Requirements
1. Provide seismic restraints for all vibration isolated equipment, ductwork and piping.
2. Restrain supported and suspended equipment and piping by devices capable of restraint in all three mutually orthogonal directions.
3. For suspended equipment, utilize stranded steel aircraft cable plus modifications to isolators to prevent excessive vertical motion.
4. Seismic restraints must be installed and adjusted so equipment and piping vibration isolation is not degraded by utilization of restraints.

2.3 FLEXIBLE CONNECTORS

A. Manufacturers
1. Mason Industries, Inc.
2. Amber Booth.

B. Neoprene Connectors
1. Use flexible EPDM connectors on equipment as indicated on drawings or on equipment schedule, manufactured of multiple layers of frictioned nylon cord with EPDM cover and liner. Do not use steel wire or rings as internal pressure reinforcement. Provide straight connectors with two spheres with a centered molded external ductile iron ring to maintain two spherical shapes. Two inch and smaller sizes may have threaded ends. Provide floating flanges with recess to lock bead wire in raised face EPDM flanges. Use tapered twin sphere connectors as described above where line size changes are required in straight piping runs.
2. Flanged equipment may be directly connected to neoprene elbows in size range 2-1/2 to 12 inches, if piping makes 90 degree turn and flanges are equal sized. Long radius reducing EPDM elbows may be used in place of steel or cast iron elbows at pump connections.
3. When pressure would cause connector to extend beyond its rated elongation, employ control rods using 1-1/2-inch thick bridge-bearing neoprene washer bushings designed for maximum loading of 1000 psi.
4. Provide twin sphere connectors with minimum rating of 250 psi at 170 degree F and 165 psi at 250 degree F. Provide elbows and reducing twin spheres with minimum pressure rating of 220 psi at 170 degree F and 145 psi at 250 degree F. Limit neoprene materials

to 220 degree F. Certified safety factors must be a nominal 4 to 1 with minimum acceptable test results of 3.6 to 1. Tests must cover burst, flange leakage, extension without control rods and flange retention at 50 percent of burst pressure without control rods.

5. Include in submittals test reports by independent consultants showing minimum reduction of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

C. Flexible Stainless Steel Hose

1. Provide flexible stainless steel hose with stainless steel braid and carbon steel fittings. Provide flanged fittings for sizes 3-inch and larger, and make nipples for smaller sizes. Use bronze braided flexible hose with female sweat ends for copper lines. Install hoses on equipment side of shut-off valves horizontally and parallel to equipment shafts whenever possible. Flexible metal hose must be Type BSS or BFF.

PART 3 EXECUTION

3.1 GENERAL

A. Isolate plumbing equipment from building structure by means of noise and vibration isolators.

B. Install isolators in accordance with manufacturer's written instructions.

C. Vibration isolators must not cause change of position of equipment or piping resulting in piping stresses or misalignment.

D. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system.

1. Loop electrical conduit connections to isolated equipment to allow free motion.

E. Do not use isolator leveling bolts as jacking screws.

F. Verify that installed isolators and mounting systems permit equipment motion in all directions.

G. Install vibration isolators for motor driven equipment.

3.2 SEISMIC CONTROL

A. Provide seismic restraints for pipes and equipment per CBC, CMC, and CPC, including pipes above roofs, supported from below.

B. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.

C. Provide approved resilient restraining devices as required to prevent equipment and piping motion in excess of 1/4 inch.

D. Provide capability of safely accepting external forces without failures.

E. Do not short circuit vibration isolation systems or transmit objectionable vibration or noise.

F. Provide restraint for piping in mechanical rooms for pipe sizes covered by SMACNA.

G. Designs: Where designs, etc., are neither indicated nor referenced, submit such designs, together with supporting calculations prepared by Structural Engineer registered in the State of California. Calculations must substantiate seismic restraint capability to safely accept external forces without failure and maintain equipment in position.

H. Rigidly Supported Piping
   1. Where required for all systems, except sprinkler piping system, restrain per SMACNA seismic standards.

I. Flexibly Supported Piping
   1. Provide and locate restraints to allow normal operation of systems without transmitting vibrations to building structure.
   2. Locations of Restraints: Per SMACNA and Factory Mutual where applicable.
   3. Construction of Restraint: Steel cables, installed slack, may be used.

3.3 EQUIPMENT ISOLATION AND SEISMIC CONTROL

A. Position equipment and structural base on blocks or wedges at proper operating height. Set steel bases for 1-inch clearance between pad and base. Set concrete bases for 2-inch clearance.

B. Provide operating load conditions prior to transferring base isolator loads to springs and remove wedges.

C. Adjust or provide additional resilient restraints to flexibly limit startup equipment lateral motion to 1/4 inch.

D. Prior to startup, clean out all foreign matter between bases and equipment.

E. Verify that there are no isolation short circuits in the base, isolators or seismic restraints.

F. Position all corner or side seismic restraints with equipment operating for proper operating clearance.

3.4 PIPING ISOLATION AND SEISMIC RESTRAINT

A. Isolate piping outside of shafts as follows:
   1. Water piping 1-1/4 inch and larger in mechanical equipment rooms: Within 50 feet or 100 pipe diameters whichever is smaller, of connected rotating equipment and pressure reducing stations.
      a. Piping where exposed on roof.

B. Provide spring isolators on piping connected to isolated equipment as follows:
   1. Up to 4 inches in diameter, first 3 points of support.
   2. 1.5 to 8 inches in diameter, first 4 points of support.
   3. 10 inches and over in diameter, first 6 points of support.
   4. Static deflection of first point must be twice deflection of isolated equipment.

C. Locate Isolators:
   1. Close to building structure.
      a. Hanger boxes butted to ceiling structure.

2. Between building structure and supplementary steel if required.

D. Supplementary steel to be sized for maximum deflection of 0.08 inches at center span.

E. Seismic restraint spacing must be in accordance with specified hanger spacing.

F. Provide Seismic Restraint For All Piping:
1. In equipment room.
2. On roofs.
3. In shafts and in ceiling of occupied spaces.

3.5 FIELD QUALITY CONTROL

A. Provide inspection by manufacturer's representative of all vibration isolating devices after installation of all devices.

B. Submit written report by manufacturer regarding installation error, improper selection of devices, and other faults that could affect performance of system. Include report on steps to properly complete isolation work.

END OF SECTION 21 05 48

SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe Markers.
2. Valve Tags.
3. Equipment Nameplates.
4. Underground Marking Tape.
5. Duct Lables.

1.2 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit in accordance with Division 1.

B. Product Data: Indicate model, type, and application usage.

C. Submit list of wording, symbols, letter size**,** letter style, and color coding for each system and vault cover.

D. Submit valve numbering scheme**,** valve chart and schedule, including valve tag number, location, function type, and valve manufacturer's name and model number.

1.4 COORDINATION

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations and valve and equipment numbering schemes prior to submittal review.

B. Coordinate installation of identifying devices with completion of covering of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment. If not installed before ceiling is installed, the Contractor must remove ceiling at no additional cost to the Owner and install identifying devices.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seton Name Plate Corp.

B. Brimar.

C. BradY.

2.2 PIPE MARKERS

A. Markers: ASME A13.1.
1. Pressure sensitive vinyl (self sticking) material.
2. Mechanically fastened type: Snap on or strap on.
   a. For dirty, greasy, or oily pipe where pressure sensitive markers may not perform satisfactorily.
3. All weather film for outdoor exposed piping.
4. Provide 360 degree and pipe flow arrows and fluid being conveyed.
5. Size of letters legend:

OUTSIDE DIAMETER OF PIPE OR PIPE COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS AND ARROWS
3/4 to 1-1/4 inch	8 inch	1/2 inch
1-1/2 to 2 inch	8 inch	3/4 inch
2-1/2 to 6 inch	12 inch	1-1/4 inch
8 to 10 inches	24 inch	2-1/2 inch
Over 10 inches	32 inch	3-1/2 inch
Ductwork		2-1/2 inch

2.3 VALVE TAGS

A. Tags: Brass or anodized aluminum type.
1. Brass: Minimum 19 gauge, polished, 2-Inch diameter with following lettering:
   a. Service: ¼-inch stamped black filled letters.
   b. Valve numbers: 3/8-inch stamped black filled letters.
2. Aluminum: 2-inch diameter, 0.032-inch thick, with following lettering:
   a. Service: ¼-inch engraved letters.
   b. Valve numbers: 3/8-inch engraved letters.

B. Fasteners: 4 ply 0.018 copper or monel wire meter seals, brass “S” hooks or No. 16 brass jack chain.

2.4 EQUIPMENT NAME PLATES

A. 1/8-inch rigid plastic or bakelite with 4 edges beveled, with black background and white border and letters.
1. Two 3/8-inch mounting holes.
2. Minimum ½-inch high lettering.
3. Commercial quality, rust resisting nuts and bolts with backwashers, self tapping screws or rivets.

2.5 UNDERGROUND MARKING TAPE

A. General: Provide underground pipe marking tape on all pipes buried beneath the ground. Provide a continuous length of tape 12 inches below the finished earth surface directly above the buried pipe. Provide a second continuous length of tape 12 inches above the top of the

buried pipe if the top of the pipe is lower than 36 inches from the top of the finished earth surface.

B. Tape: 5 mil inert plastic film for underground use.

C. Resistant to alkalis, acids and other destructive agents found in soil; information in the Geotechnical Report.

D. Minimum tensile strength: 120 pounds per 6-inch width.

E. Minimum elongation: 500 percent.

F. Provide detectable underground tape above all buried pipes on the Project. Provide a continuous printed message repeated every 16 to 36 inches warning of pipe buried below similar to (i.e., “CAUTION FIRE SPRINKLER LINE BURIED BELOW”).

G. Color code:
   1. Yellow: Natural gas.

H. Provide tape widths of 2, 3, 6, 9, and 12 inches for lines buried 10, 20, 30, 40, and 50 inches or greater, respectively.

2.6 CHART AND DIAGRAM FRAMES

A. Chart and diagram frames: Extruded aluminum with plexiglass or glass windows.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 VALVE AND EQUIPMENT IDENTIFICATION

A. Designate all equipment, valves, dampers and terminal units by distinguishing numbers and letters on charts and/or diagrams.
   1. Tag and locate following equipment items:
      a. Valves.
      b. All items indicated on equipment schedules.
   2. Designation must match that indicated.

B. Install tags on all devices with numbers and letters corresponding to charts.

C. Fasten tags securely to devices with tag fasteners in manner for easy reading.

D. Attach equipment nameplates in conspicuous location, directly on item of equipment or apparatus such as piping, and valves.

E. For unsuitable surfaces, such as high temperature or lack of space, use copper or brass rings or chains to attach tags.

F. Furnish 4 charts.

1. Mount 1 chart in frame and secure on wall in location directed by OWNER Representative.
2. Include remaining 3 sets in “Operation and Maintenance Manuals”.
3. Show valve tag numbers on project as-built drawings.

G. Provide safety sign for each piece of exposed mechanical equipment that may start automatically.

3.3 PIPE IDENTIFICATION

A. Locate pipe markers as follows:
1. Next to each valve and fitting.
2. At each branch or riser take off.
3. At each passage through walls, floors and ceilings.
4. At each pipe passage to underground.
5. On all horizontal pipe runs every 20 feet, at least once in each room and each story traversed by piping system.
6. Identify piping contents, flow direction.

B. Install markers with tape color bands over each end of marker, extending around pipe and overlapping a minimum of 30 degrees.

3.4 SERVICE ABBREVIATIONS

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations as indicated below:
1. FS Fire Sprinkler

3.5 INSTALLATION OF UNDERGROUND MARKING TAPE

A. Install underground marking tape directly above all outside utility lines.

B. Allow 12 inches between tape and line, and install as close to grade level as feasible.

3.6 CONTROL DIAGRAMS AND INSTRUCTIONS

A. Provide HVAC control and systems instructions and diagrams in wall mounted frames. Mount framed diagrams in conspicuous, easily accessible places in equipment rooms housing appropriate HVAC system.

B. Diagrams and instructions may be reduced in size provided they are legible and lettering is not smaller than “elite” type of standard typewriter.

END OF SECTION

SECTION 21 10 00 - WATER-BASED FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Settlement Joint
2. Pipe, Fittings, Valves and Connections for Sprinkler Systems.
3. Sprinkler Heads.
4. Fire Department Connections.
5. Alarm Devices.
6. Fire Suppression Standpipes.

1.2 REFERENCES

A. National Fire Protection Association (NFPA)
1. NFPA 13 - Installation of Sprinkler Systems.
2. NFPA 14 - Installation of Standpipe and Hose Systems.
3. NFPA 15 - Water Spray Fixed Systems for Fire Protection.
4. NFPA 20 - Installation of Centrifugal Fire Pumps.
5. NFPA 24 - Installation of Private Fire Service Mains and their Appurtenances.
6. NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
7. NFPA 72 - National Fire Alarm Code.
8. NFPA 230 - Fire Protection of Storage.
9. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants.
10. NFPA 1961 - Fire Hose.
11. NFPA 1963 - Fire Hose Connections.

B. Factory Mutual Systems (FM) Publications
1. Approval Guide.

C. Underwriter’s Laboratories, Inc. (UL) Publications
1. Fire Protection Equipment Directory.

D. ASME
1. B1.20.1 - Pipe Threads, General Purpose.
2. B16.3 - Malleable Iron Threaded Fittings.
3. B16.4 - Gray Iron Threaded Fittings Class 125 and 250.
4. B16.5 - Pipe Flanges and Flanged Fittings.
5. B16.9 - Factory-Made Wrought Buttwelding Fittings.
6. B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
7. B16.25 - Buttwelding Ends.
8. B36.10 - Welded and Seamless Wrought Steel Pipe.

E. ASTM International
1. A47 - Ferritic Malleable Iron Castings.
2. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. A135 - Electric-Resistance-Welded Steel Pipe.

4. A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. A536-84 - Ductile Iron Castings.
6. C635 - Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
7. C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

F. Underwriter's Laboratories (UL)
1. UL 193 - Warm Valves for Fire-Protection Service.
2. UL 194 - Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire Protection Service.
3. UL 213 - Rubber Gasketed Fittings for Fire Protection Service.
4. UL 262 - Gate Valves for Fire-Protection Service.
5. UL 312 - Check Valves for Fire-Protection Service.
6. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.
7. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
8. UL 405 - Fire Department Connections.
9. UL 464 - Audible Signal Appliances.
10. UL 753 - Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.
11. UL 1091 - Butterfly Valves for Fire-Protection Service.
12. UL 1468 - Direct Acting Pressure Reducing and Pressure Restricting Valves.
13. UL 1474 - Adjustable Drop Nipples for Sprinkler Systems.
14. UL 1726 - Automatic Drain Valves for Standpipe Systems.

G. AWWA C105 - Polethylene Encasement for Ductile-Iron Pipe Systems.

H. AWWA C151/ ANSI A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water.

I. AWWA C110/ ANSI A21.1D - Ductile-Iron and Gray-Iron Fittings for Water.

J. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

K. ANSI/ ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.

L. AWWA C510 - Double Check Valve Backflow-Prevention Assembly.

M. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly.

1.3 DEFINITIONS
1. Working plans as used in this Section refer to Contract Documents (including Drawings and calculations) prepared pursuant to requirements in NFPA 13 for obtaining approval of authority having jurisdiction.
2. Other definitions for fire protection systems are included in referenced NFPA standards.

1.4 SYSTEM DESCRIPTION

A. Design Requirements
1. Wet Pipe Sprinkler System Description: This system must be installed in conformance with NFPA 13. All materials utilized must be UL listed and approved. All materials

installed must adhere to the manufacturer's installation guidelines. System devices must include the following:

a. Sprinkler Heads: As indicated in Part 2 of this Section.

2. Fire Hose Cabinets and Fire Valve Cabinets: The fire hose cabinets, fire hose/valve cabinets and fire valve cabinets are specified in Section 10 44 13 and installed by this Contractor-. This Contractor must field install the following:
   a. Hose (100-ft); angle valve, escutcheon, rack nipple; coupling and hose rack as required to make assembly meet NFPA 13, for fire hose cabinets.
   b. Hose (100-ft); angle valve, escutcheon, rack nipple; coupling and hose rack; and fire department valve as required to make assembly meet NFPA 13, for fire hose/valve cabinets.
   c. Fire department valve and escutcheon as required to make assembly meet NFPA 13, for valve cabinet.

B. Performance Requirements

1. Work provided under this Section must include, but not be limited to, complete automatic sprinkler system as outlined in this Section, including all labor, materials and shop drawings needed to provide an operating system, and all of the following:
   a. Connection to fire service mains.
   b. Backflow preventer.
   c. Automatic sprinklers and appropriate escutcheons.
   d. Flexible sprinkler hose fitting.
   e. Control and check valves.
   f. Drain and test valves.
   g. Pipe, fittings, and auxiliary drains.
   h. Hangers and supports including seismic restraints, and any required calculations.
   i. Sleeves including firestopping and watertight sealants.
   j. Ceiling and wall plates.
   k. Cutting and patching.
   l. Signs, pipe identification, and flow arrows.
   m. Fire department connection.
   n. Waterflow alarms (paddle type and pressure-type).
   o. Supervisory devices.
   p. Coordination with all other trades including the subcontractor providing the detection and actuation system.
   q. Shop drawings, hydraulic calculations, device manufacturer's literature, and samples.
   r. Air tests, hydrostatic tests, Contractor's Material and Test Certificates and as-built drawings.
   s. Training and operating instructions.
   t. Spare parts/sprinklers in cabinet with special wrenches.
   u. All permits and fees for this work.
2. The design must conform to NFPA 13 and the requirements specified in this Section. Design of the automatic wet pipe sprinkler system must be for Light Hazard and Ordinary Hazard Group 1.
3. The fire protection system includes fire water service from a point approximately 5-feet outside each Building to all spaces as indicated on the Fire Protection Plans and as required by NFPA 13. The underground piping design must be in accordance with NFPA 24. The system must include all materials, accessories and equipment inside and outside the building to provide a system complete and ready for use. Design and provide each system giving full consideration to inmate access, blind spaces, HVAC and

plumbing piping, electrical equipment, ductwork and other construction and equipment in accordance with detailed drawings to be submitted for approval. Equipment for fire protection service must be UL listed or FM approved for use in a wet pipe sprinkler system.

4. Sprinkler System Protection Limits: All spaces within each building except as noted on the Fire Protection Plans. Include plumbing chases, closets, toilet and locker room areas cells, each stairway, warming kitchen, day room, and special applications areas.
    a. Exception: Areas with other fire extinguishing systems and areas indicated to be without sprinkler protection.
    b. Commercial sprinklers must be provided in areas as indicated on the Fire Protection Plans. Part 2 of this Section contains detailed sprinkler requirements.
    c. The type of sprinkler head to be used in each room is indicated on the Fire Protection Plans. Contractor must submit in writing to the OWNER Representative the type of sprinkler heads used in each room for each building.
5. Water Distribution: Distribution must be uniform throughout each Building, which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area must be between 100 and 200 percent of the specified density.
6. Piping Restrictions: Piping is prohibited in the following areas, except when solely supplying sprinklers in such areas:
    a. Electrical Rooms and Electrical Closets.
    b. Communication Rooms, Telephone Rooms and Telephone Closets.
7. Clearance from Electrical Equipment: Piping and automatic sprinklers are prohibited directly over:
    a. Transformers.
    b. Substations.
    c. Switchboards.
    d. Motor Control Centers.
    e. Emergency Generators.
    f. Bus Ducts.
    g. Electrical Panels.
    h. If installing pipe over electrical equipment is unavoidable, provide a galvanized drip pan under piping to protect electrical equipment. Provide 1/2-inch drain pipe from pan and terminate 6-inches above floor.
8. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads must not exceed their linked area coverage for Light Hazard and Ordinary Hazard Group 1, as indicated. Uniformly space sprinklers on the branch piping. Locate sprinkler heads in a consistent pattern with ceiling grid, lights and supply air diffusers. Locate sprinkler heads in center of tiles.
9. Sprinkler Discharge Area: The sprinkler discharge area must be the hydraulically most remote areas as defined in NFPA 13 and 230.
10. Hose Allowances: System design must include a combined inside and outside hose allowance based on sprinkler hazard classification:
    a. Light Hazard: 100 GPM.
    b. Ordinary Hazard 1: 250 GPM.
    c. Ordinary Hazard 2: 250 GPM.
    d. Extra Hazard: 500 GPM.
11. Hydraulic Calculations must be performed in accordance with NFPA 13 and 15. A minimum 10 psi cushion or safety factor/margin, between the available pressure and the calculated required pressure must be incorporated into all hydraulic calculations.

12. The Contractor must provide system demands at base of risers. Available water supply at risers must be coordinated with the Engineer. As stated above, confirm pressure with Engineer prior to performing calculations.
13. Hydraulic Calculations: Hydraulic calculations for each building must be in conformance with NFPA 13 and the following requirements:
    a. The Contractor, within one year of the submittal of final working drawings, must conduct an up-to date fire flow test indicating the static and residual pressure in the water mains used for fire service with certified flow volumes at time of test. Tests must be conducted at or near peak demand of day.
    b. The Contractor must coordinate with Engineer fire service water pressures for the entire site, as specified in Number 13 above.
    c. Densities listed below are for the most hydraulically remove areas pus hose streams.

Occupancy	Density GPM/Sq.Ft.	Remote Area Sq.Ft.
Light Hazard Office Bedroom Washroom Hall Living Dining Kitchen	0.10	1500
Ordinary Hazard Group 1 Apparatus Bay Electrical Room Utility	0.15	1500

    1) Electrical Rooms and Apparatus Bay to be hydraulically designed to provide a design density of 0.20 gpm/sq.ft. over the most remote 2,000 sq.ft.
    2) Note: Maximum allowable velocity for inside piping, if velocity pressures are used, is 32 FPS. If velocity pressures are not used, velocities should not exceed 20 FPS, except for riser nipples and starter pieces used for throttling to achieve balance flows. Underground pipe velocities should not exceed 16 FPS.

    d. Components and Installation: Capable of producing piping systems with the following minimum working pressure rating except where indicated otherwise:
        1) Sprinkler Systems: 175 psig.

1.5 TOLERANCES

A. The Contractor must furnish on a design/build basis, all equipment, materials, tools, labor, engineering, drawings, and accessories, necessary for complete fire protection systems, with said systems being made ready for operation. The purpose of the Specifications and Drawings is to convey to the Contractor the scope of design/build work required, all of which the Contractor must furnish, install, adjust, and make operable, and to meet the requirements of the California State Fire Marshal.

B. The omission of any necessary system component must not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the OWNER. Any case of error, omission, discrepancy or lack of clarity must be promptly identified to the OWNER Representative for clarification prior to the bid due date.

C. The Contractor must provide all devices and equipment required by these Specifications and Drawings and the Authority Having Jurisdiction. Under no circumstances must the Contractor delete any equipment or devices without written directive of the Authority Having Jurisdiction.

D. Installation of the fire suppression system must not be started until all plans and specifications have been approved by the Authority Having Jurisdiction.

1.6 SUBMITTALS

A. Partial submittals will not be acceptable. Before any work is commenced, submit manufacturer's data (with listing or approval), system calculations, water supply data, and complete sets of working drawings.

B. Manufacturer's Data: Annotate descriptive data to show the specific model, type and size of each item the Contractor proposes to furnish. Where any devices which are provided or furnished involve work by another trade, submit additional data copies directly to the subcontractor. Where manufacturer's data sheets show multiple equipment or model numbers, indicate with an arrow the equipment to be provided.
1. Pipe, fittings and seismic supports.
2. Alarm valves.
3. Gate and check valves.
4. Globe valves.
5. Backflow preventers.
6. Sprinklers and escutcheons.
7. Pipe hangers and supports.
8. Pressure and waterflow switches.
9. Tamper switches.
10. Inspector's test station.
11. Retard chamber.
12. Ball drip.
13. Fire department connections.
14. Lubricating compound / PTFE tape.
15. Signs.
16. Caps, Chains.
17. Cabinets.
18. Hose Valves.
19. Drip pans.
20. Dielectric unions.
21. Underground piping support, anchoring methods, and pipe wrap.
22. Corrosion protection and coating materials for underground pipe rodding.
23. Signs, pipe identification, and flow direction.
24. Flexible sprinkler hose fittings.

C. Shop Drawings:

1. Submit to the OWNER Representative: Shop drawings, hydraulic calculations and manufacturer's data as required to obtain approval of all applicable local, state, federal and insurance authorities in accordance with Section 01 33 23.
2. After obtaining approval of shop drawings from the OWNER Representative, submit to the Authority Having Jurisdiction one (1) set of shop drawings, hydraulic calculations and manufacturer's data as required to obtain approval.
3. Submit to the OWNER Representative: One set of shop drawings and manufacturer's data bearing the review stamp of all applicable local, state, federal and insurance authorities.
4. Hydraulic calculations must include a water supply graph and hydraulic cover sheet. The cover sheet must include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, size, K factor and temperature rating, flow requirements, C factor used, water supply data and source of information, and commodity storage class, height and configuration.
5. Prepare shop drawings at minimum scale of 1/8-inch equals 1 foot for plans, and 1/4-inch equals 1 foot for details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, roof construction, and occupancy of each area, including ceiling and roof heights as required by NFPA 13. When welding is planned, shop drawings must indicate the sections to be shop welded and the type of welded fittings to be used.
6. Shop drawings must include details of earthquake sway bracing with any required calculations, sealed by a Professional Structural Engineer licensed in the State of California.

D. Changes:
1. Make no changes in installation from layout as shown on the approved Drawings unless change is specifically approved by the OWNER Representative. This does not include minor revisions for the purpose of coordination.
2. Any pipe fabricated and/or installed before all approvals are obtained are at the Contractor's own expense and responsibility. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.

E. As-Built and Project Record Drawings:
1. In accordance with Division 1, maintain at the site an up-to-date set of as-built drawings which must be corrected daily and delivered to the OWNER upon completion of the Work.
2. The Contractor must utilize the marked up drawings to produce a set of Project Record Drawings. Upon completion furnish the OWNER Representative with four (4) sets of prints and one set in electronic AutoCAD 2005 "DWG" format of each approved shop drawing, revised to show "as-built" conditions in accordance with Division 1.

F. Fire Zone Sprinkler Head Identification:
1. The Contractor must prepare AutoCAD drawings identifying (by zone and number) each sprinkler head associated with each fire zone. These drawings are to be framed in tamperproof glass and mounted on the wall or as per the direction of the OWNER Representative.

G. Final Inspection and Test:
1. Upon completion of final inspections and tests, as required by appropriate NFPA Standards and these Specifications, submit documentation of all test results and copies

of the Standard Contractor's Material and Test Certificates to the OWNER Representative.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL Fire Protection Equipment Directory and FM Approval Guide and that conform to other requirements indicated.

B. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

C. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in "California Electrical Code," Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Comply with requirements of authority having jurisdiction for submittals, approvals, materials, hose threads, installation, inspections, and testing.

E. Comply with requirements of OWNER's insurance underwriter for submittals, approvals, materials, installation, inspections, and testing.

F. Licensed Fire Sprinkler Contractor: Submit design drawings, Fire Protection design calculations, and installation inspection reports, sealed by a Fire Sprinkler Contractor licensed in the State of California, certifying compliance with specifications.

G. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced (minimum of 5 previous projects similar in size and scope to this Project) in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. Submit evidence of qualifications to the OWNER Representative upon request. Refer to Division 1.

H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
   1. NFPA 13.
   2. California Electrical Code (CEC), latest edition.
   3. NFPA 230.

1.8 DELIVERY, STORAGE AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

B. Provide temporary protective coating on cast iron and steel valves.

C. Certificates: Submit mill certificates indicating steel pipe for use in above-ground sprinkler piping conforms to specified requirements.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment and ductwork, all plumbing systems, and partition assemblies.

B. MAINTENANCE SERVICE - Initial Maintenance Service: Beginning at Project completion, provide one year's emergency repair service by skilled employees of sprinkler/standpipe system Installer.
   1. Include 24-hour-per-day, 7-day-per-week emergency callback service.
      a. Response Time: Four hours or less.

1.10 EXTRA MATERIALS

A. Provide spare sprinkler cabinets, complete with sprinklers of assorted temperature ratings of the type necessary and in use throughout the installation as required by NFPA 13. Each cabinet must be equipped with one special sprinkler wrench required for each type of sprinkler installed.
   1. Confer with the OWNER Representative for exact locations for sprinkler cabinets.

PART 2 PRODUCTS

2.1 PIPE WRAP FOR BELOW GROUND FIRE WATER SERVICE

A. General: Provide pipe wrap for all pipe installed below ground.
   1. Cleaning: Remove loose scale, rust, dirt, oil and grease before wrapping. Wire brush as required; use solvent for removal of oil and grease.
   2. Encase in two (2) layers of an AWWA C105, 8-mil polyethylene jacket, all ductile iron pipe installed below ground. Install jacket per AWWA C105.

2.2 MATERIALS - GENERAL

A. All components must be UL listed or FM approved for the intended purpose. Components must be used in accordance with the manufacturer’s recommendations and its UL listing and/or FM approval.

2.3 PIPES AND FITTINGS

A. Underground Piping Systems:
   1. General: Provide outside-coated, ductile-iron, cement-mortar lined pipe and fittings conforming to NFPA 24, and AWWA C151/A21.51 for piping, and AWWA C110/ANSI A21.10 for fittings. Anchor joints in accordance with NFPA 24. Provide concrete thrust blocks or other suitable means of thrust restraint in accordance with NFPA 24. Restrain the pipe riser with steel rods from the elbow where the pipe turns up toward the floor, to the flange above the floor. Minimum pipe size must be as shown. Minimum depth of cover must be such that the top of the pipe is not less than 36-inches below finished grade.
   2. Mechanical Joints: Dimensional and material requirements for pipe ends, gland bolts and nuts, and gaskets must conform to AWWA C111. Mechanical joints must also meet the requirements of UL 194.
   3. Back-fill Materials:

a. Granular Fill: Granular fill for filling over excavations and for bedding of pipes dial consist of approved, uniformly graded, sand, stone, gravel, or stone screening free from an excess of soft or unsound particles or other objectionable material.

b. Soil Materials: Soil materials used as backfill for trenches must consist of approved native material that is free from debris, wood roots, scrap materials and other vegetable matter and refuse.

4. Buried Utility Warning and Identification Tape: Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warming and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape in rolls, 3-inch minimum width, color coded for the utility involved with warning and identification imprinted in bold black lettering continuously and repeatedly over the entire tape length. Warning and identification must be CAUTION BURIED WATER PIPING BELOW or similar. Use permanent code and letter coloring unaffected by moisture and or the substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12-inches below the top surface of the earth or the top surface of the subgrade under pavements.

B. Above Ground Piping:

1. General: Provide fittings for changes in direction of piping and for all connections. Arrange piping so that it can be drained at the main riser. Make changes in piping sizes through standard tapered, reducing pipe fittings; the use of bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Jointing compound for pipe threads must be polytetrafluoroethylene (PTFE) pipe thread tape ONLY; apply on male threads. Lubricant used on gaskets for mechanical fittings must be non-petroleum based and approved by the OWNER Representative. Run piping concealed in areas with suspended ceilings, except as otherwise noted on the Drawings.

2. Pipe must be new, designed for 175 psi, non-shock, cold water working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.

a. Steel: Steel piping must be black or galvanized.

1) Standard Wall: Overhead pipe used must be black steel and must comply with ASTM A135. Galvanized pipe must be used where exposed to atmosphere and for dry systems. Dimensions for all overhead pipe must be in accordance with the American Standard for Wrought Steel and Wrought Iron Pipe ASME B36.10M for pressure up to 300 psi. Schedule 40 pipe is considered "standard wall" pipe. Schedule 30 pipe is, acceptable in sizes 8-inch and larger. Standard wall pipe ends must be welded, threaded, cut grooved or plain end.

2) Thin Wall: Overhead pipe of the Welded and Seamless Type specified in ASTM A53 used in welded systems must have a minimum pipe wall thickness for pressures up to 300 psi as follows: Schedule 10 in sizes up to 5-inch; 0.134 inches for 6-inch; and 0.188 inches for 8-inch pipe. Pipe ends must be roll grooved or welded in accordance with NFPA 13.

3) Threadable light wall piping must not be used.

4) Pipe and preparation must conform to the fitting manufacturer's recommendations.

2.4 FITTINGS

A. Piping connections for steel pipe must be threaded, flanged or grooved, and rated for 175 psi working pressure. Piping connections for stainless steel must be stainless steel. Plain end

fittings and couplings are not permitted. All fittings must be suitable for use in sprinkler and standpipe systems in accordance with NFPA 13 and 14.

1. Steel Pipe:
   a. Threaded fittings must be cast iron, 125 pound class, black, and in accordance with ASME B16.4; or malleable iron, 150 pound class, black and in accordance with ASME B16.3. Bushings must not be used unless written approval is obtained from the Owner. Threaded fittings on deluge system located outside must be malleable.
   b. Welded fittings must be steel, standard weights, black, and in accordance with ASME B16.9, ASME B16.25, ASME B16.5, ASME B16.11 and ASTM A234.
   c. Grooved fittings must be malleable or ductile iron joined with rigid or flexible couplings with approved gaskets. Groove-type fittings must be UL listed or FM approved for fire protection: Fittings must be manufactured by Victaulic, Gustin-Bacon, or approved equal.
   d. Grooved couplings and reducers must be malleable or ductile iron conforming to ASTM A47. Grooved couplings to be malleable or ductile iron having clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; composition sealing gaskets recommended by the manufacturer, steel bolts, nuts, and washers. Use hot-dipped galvanized couplings for galvanized pipe. Coupling gasket must be molded Elastomer (EPDM) Victaulic grade “E” (TYPE A), Gustin-Bacon Type W or as otherwise recommended by the manufacturer for dry pipe systems, or equal. Grooved couplings and reducers must be of the same manufacturer as used for the grooved fittings. Grooved couplings may be of flexible or rigid type.
   e. Flanged fittings must be Class 150 steel, rated at 200 psi working pressure and provided to match adjacent equipment or fittings. Where using bolt connections, the length of the bolts must not protrude as to prevent the use of a socket wrench on associated nuts. Flanged bolts must be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B18.2.1 and ANSI B18.2.2. Bolted connections must be hot-dipped galvanized; or stainless steel bolts, nuts, and washers where exposed to outside air. Gaskets must be full-faced of 1/16-inch minimum thickness red sheet rubber.

B. Drain, trim, and test valves must be approved.
   1. Main drain, auxiliary drain and inspectors test valves must be globe valves, bronze body, rising stem, inside screw, renewable composition disc manufactured by Nibco, Stockham or equal. Globe valves up to 1-inch to be Nibco KT-65, Stockham or equal. Globe valves 1-1 /4-inches to 3-inches to be Nibco KT-211-W, Stockham or equal.
   2. Gate valves must not be used for dry pipe system inspectors test connections.

C. Check Valves:
   1. Check valves for water supply, fire department connections, and risers must have removable covers for maintenance without removing the valve from the system.
   2. Check valves in the trim must be approved.

2.5 SPRINKLERS

A. Fire Sprinkler Heads:
   1. Sprinklers must be quick response type and have a temperature classification per NFPA 13. Fire sprinklers must be of one manufacturer throughout the building. No mixing of sprinkler brands must be permitted. Sprinklers must be of all brass body construction

with a metal Belleville spring seal, coated on both sides with Teflon film. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Institutional sprinklers must have a quick response solder link. Commercial sprinklers must have a quick response frangible bulb type fusible element. Sprinklers to be installed in areas with no ceilings must be of a brass finish and must be of adequate temperature for the hazard. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy.

2. Sprinkler head types are indicated on the Fire Protection Plans. Contractor must review types of heads with the OWNER Representative prior to drawing submittal. The Contractor must submit in writing to the OWNER Representative the types of heads for each room in each building based on the meeting.

B. Commercial Quick Response Sprinklers:
   1. Quick Response Pendent Sprinkler: Sprinklers to be installed through a ceiling must be chrome finish pendent sprinklers (or finish as specified elsewhere) with an adjustable semi-recessed escutcheon of same specified finish. Sprinklers must have a quick response frangible bulb type fusible element. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Quick Response Sprinklers must be Viking SIN: VK302 (5.6K Standard Orifice Pendent) or SIN: VK352 (8.0K Large Orifice Pendent), or equal as approved by State Fire Marshal and OWNER Representative.
   2. Microfast Quick Response Upright Sprinkler: Sprinklers to be installed through a ceiling must be chrome finish pendent sprinklers (or finish as specified elsewhere) with a Viking model “E-1 or F-1” adjustable semi-recessed escutcheon of same specified finish. Sprinklers must have a quick response frangible bulb type fusible element. Sprinklers must have a standard or large orifice and a 5.6 or 8.0 nominal K Factor. Sprinklers must be UL Listed or FM Approved. Quick response sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Quick Response Sprinklers must be Viking SIN: VK300 (5.6K Standard Orifice Upright) or SIN: VK350 (8.0K Large Orifice Upright), or equal as approved by State Fire Marshal and OWNER Representative.
   3. Quick Response Concealed Horizontal Sidewall Sprinkler: Quick response concealed horizontal sidewall sprinklers must be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy. Sprinklers must have a quick response frangible bulb type fusible element. Concealed horizontal sidewall sprinklers must have a white finish (or painted to match enclosure finish) cover plate that is a push-on, pull-off assembly with a cover diameter no greater than 2-3/4-inch. Concealed sprinklers must have a 1/2-inch NPT, a standard orifice, and a nominal K Factor of 5.6. Quick response horizontal sidewall sprinklers must be UL Listed for Light Hazard and Ordinary Hazard occupancies. Concealed Horizontal Sidewall Sprinklers must be Viking SIN: VK408 (Base Part Number 11451), or equal as approved by State Fire Marshal and OWNER Representative.

C. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Provide sprinkler guards for all sprinkler heads located in water heater room.

D. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and one wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.

2.6 FLEXIBLE SPRINKLER HOSE FITTINGS

A. The use of flexible sprinkler hose fittings is allowed as long is the assembly components are listed and installed in accordance with the requirements of the listing. Flexible fittings must be listed and approved by the Authority Having Jurisdiction. Compliance with NFPA 13 are required as follows:
   1. When installed and supported by suspended ceilings, the ceiling must meet ASTM C635 and must be installed in accordance with ASTM C636.
   2. Where flexible sprinkler hose fittings exceed 6-feet in length and are supported by a suspended ceiling, hangers attached to the structure must be required to ensure that the maximum unsupported length does not exceed 6-feet.
   3. The suspended ceiling anchoring components must be attached to the ceiling support with tamper resistant self-tapping zip screws.

B. Flexible sprinkler hose fittings must be Flexhead Industries or an approved equal.

2.7 DIELECTRIC FITTINGS

A. Assembly must be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180-degree F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
   1. Available Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Hart Industries International, Inc.
      e. Watts Industries, Inc.; Water Products Div.
      f. Zurn Industries, Inc.; Wilkins Div.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
   1. Available Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.

D. Dielectric Flange Insulation Kits: Components for field assembly must include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
   1. Available Manufacturers:
      a. Advance Products and Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.

E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225-degree F.
   1. Available Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225-degree F.
   1. Available Manufacturers:
      a. Perfection Corporation.
      b. Precision Plumbing Products, Inc.
      c. Victaulic Co. of America.

2.8 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings must be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings must have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping system.

B. Outlet Specialty Fittings:
   1. Available Manufacturers:
      a. Anvil International, Inc.
      b. Central Sprinkler Corp.
      c. Ductilic, Inc.
      d. JDH Pacific, Inc.
      e. National Fittings, Inc.
      f. Shurjoint Piping Products, Inc.
      g. Southwestern Pipe, Inc.
      h. Star Pipe Products; Star Fittings Div.
      i. Victaulic Co. of America.
      j. Ward Manufacturing.
   2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
   3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
   1. Available Manufacturers:
      a. Central Sprinkler Corp.
      b. Fire-End and Croker Corp.
      c. Viking Corp.
      d. Victaulic Co. of America.

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
   1. Available Manufacturers:
      a. Elkhart Brass Mfg. Co., Inc.
      b. Fire-End and Croker Corp.
      c. Potter-Roemer; Fire-Protection Div.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
   1. Available Manufacturers:
      a. AGF Manufacturing Co.
      b. Central Sprinkler Corp.
      c. G/J Innovations, Inc.
      d. Triple R Specialty of Ajax, Inc.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
   1. Available Manufacturers:
      a. CECA, LLC.
      b. Merit.

2.9 LISTED FIRE-PROTECTION VALVES

A. Valves must be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves must have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

B. Gate Valves with Wall Indicator Posts:
   1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
   2. Available Manufacturers:
      a. Grinnell Fire Protection.
      b. McWane, Inc.; Kennedy Valve Div.
      c. NIBCO.
      d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
   1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   3. NPS 3: Ductile-iron body with grooved ends.
   4. Available Manufacturers:
      a. NIBCO.
      b. Victaulic Co. of America.

D. Globe or Angle Valves
   1. NPS 2 and smaller: Bronze body, bronze trim, rising stem and handwheel inside screw, renewable composition disc, solder or screwed ends, with backseating capacity repackable under pressure.
   2. Over NPS 2: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
   3. Available Manufacturers:
      a. NIBCO
      b. Grinnell Fire Protection
      c. Stockham

E. Butterfly Valves: UL 1091.
   1. NPS 2 and Smaller: Bronze body with threaded ends.
      a. Available Manufacturers:
         1) Global Safety Products, Inc.

2) Milwaukee Valve Company.

2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
3. Available Manufacturers:
   a. Central Sprinkler Corp.
   b. Global Safety Products, Inc.
   c. McWane, Inc.; Kennedy Valve Div.
   d. Mueller Company.
   e. NIBCO.
   f. Pratt, Henry Company.
   g. Victaulic Co. of America.

F. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Available Manufacturers:
   a. Central Sprinkler Corp.
   b. Clow Valve Co.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Grinnell Fire Protection.
   e. Mueller Company.
   f. NIBCO.
   g. Potter-Roemer; Fire Protection Div.
   h. Reliable Automatic Sprinkler Co., Inc.
   i. Star Sprinkler Inc.
   j. Stockham.
   k. Victaulic Co. of America.
   l. Watts Industries, Inc.; Water Products Div.

G. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
   a. Available Manufacturers:
      1) Crane Co.; Crane Valve Group; Crane Valves.
      2) Hammond Valve.
      3) NIBCO.
      4) United Brass Works, Inc.
2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
   a. Available Manufacturers:
      1) Clow Valve Co.
      2) Crane Co.; Crane Valve Group; Crane Valves.
      3) Crane Co.; Crane Valve Group; Jenkins Valves.
      4) Hammond Valve.
      5) Milwaukee Valve Company.
      6) Mueller Company.
      7) NIBCO.
      8) Red-White Valve Corp.
      9) United Brass Works, Inc.

H. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Available Manufacturers:
   1) Milwaukee Valve Company.
   2) NIBCO.
   3) Victaulic Co. of America.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
   a. Available Manufacturers:
      1) Central Sprinkler Corp.
      2) Grinnell Fire Protection.
      3) McWane, Inc.; Kennedy Valve Div.
      4) Milwaukee Valve Company.
      5) NIBCO.
      6) Victaulic Co. of America.

I. Double Check Valve Assemblies: ANSI/ASSE 1012, AWWA C510 and AWWA C511, bronze body with corrosion resistant internal parts and stainless steel springs, two independently operating check valves: Febco Model 805YD. Use iron body assembled for 2-inch and above.

2.10 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves must have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
   1. Available Manufacturers:
      a. Central Sprinkler Corp.
      b. Globe Fire Sprinkler Corporation.
      c. Grinnell Fire Protection.
      d. Reliable Automatic Sprinkler Co., Inc.
      e. Star Sprinkler Inc.
      f. Victaulic Co. of America.
      g. Viking Corp.
   2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
      a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
      b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

B. Pressure-Regulating Valves: UL 1468, brass or bronze, NPS 1-1/2 and NPS 2-1/2, 400-psig minimum rating. Include female NPS inlet and outlet, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated.
   1. Finish: Rough metal.
   2. Available Manufacturers:
      a. AFAC Inc.
      b. Elkhart Brass Mfg. Co., Inc.
      c. Fire-End and Croker Corp.
      d. GMR International Equipment Corporation.
      e. Grinnell Fire Protection.

f. Potter-Roemer; Fire Protection Div.
g. Zurn Industries, Inc.; Wilkins Div.

C. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
1. Available Manufacturers:
a. AFAC Inc.
b. Grinnell Fire Protection.

2.11 FIRE DEPARTMENT CONNECTIONS

A. Available Manufacturers:
1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Guardian Fire Equipment Incorporated.
8. Potter-Roemer; Fire-Protection Div.
9. Reliable Automatic Sprinkler Co., Inc.
10. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
1. Type: Flush, with four inlets and square or rectangular escutcheon plate.
2. Finish: Polished chrome-plated.

C. FreeStanding-Type Fire Department Connection: UL 405 175-psig minimum pressure rating with corrosion-resistant metal body with sleeves, escutcheons, plugs, caps, and chains. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
1. Size: 4 inch.
2. Type: Freestanding with twoinlets.
3. Finish: Brass.

2.12 ALARM DEVICES

A. Alarm-device types must match piping and equipment connections.

B. Electrically Operated Alarm: UL 464, with 6-inch- minimum- 8-inch- minimum- 10-inch-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
1. Available Manufacturers:
a. Potter Electric Signal Company.
b. System Sensor.

C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   1. Available Manufacturers:
      a. ADT Security Services, Inc.
      b. Grinnell Fire Protection.
      c. ITT McDonnell & Miller.
      d. Potter Electric Signal Company.
      e. System Sensor.
      f. Viking Corp.
      g. Watts Industries, Inc.; Water Products Div.

D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
   1. Available Manufacturers:
      a. Grinnell Fire Protection.
      b. Potter Electric Signal Company.
      c. System Sensor.
      d. Viking Corp.

E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
   1. Available Manufacturers:
      a. McWane, Inc.; Kennedy Valve Div.
      b. Potter Electric Signal Company.
      c. System Sensor.

2.13 FIRE HOSES

A. Hose Rack: Steel with red enameled finish; swivel type with covered sliding pins and water stop.

B. Hose: NFA 1961, 100-feet of 1-1/2-inch PR-FLEX hose; mildew and not-resistant.

C. Nozzle: Brass, combination fog, straight stream, and adjustable shut-off.

D. Angle Valve: Adjustable pressure restricting type, 1-1/2-inch nominal size; refer to Article 2.9 of this section.

E. Fire Department Outlet Valve: Angle type; brass finish, 2-1/2-inch size, thread to match fire department hardware, 300-psig working pressure, with threaded cap and chain of same material and finish.

2.14 PRESSURE GAUGES

A. Available Manufacturers:
   1. AGF Manufacturing Co.
   2. AMETEK, Inc.; U.S. Gauge.

3. Brecco Corporation.
4. Dresser Equipment Group; Instrument Div.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2 to 4-1/2 inch diameter, dial pressure gauge with range of 0 to 300-psig.
   1. Water System Piping: Include caption “WATER” on dial face.

2.15 HANGERS AND SUPPORTS

A. Swivel rings and building attachments must be UL listed/approved.
   1. Trapeze/hanger component station module must meet or exceed values listed in NFPA 13.
   2. Earthquake sway bracing compartments must meet or exceed sizes listed in NFPA 13.

2.16 SLEEVES FOR WALL/FLOOR PENETRATIONS

A. Sleeves through walls and floors, where provided, must be of a type that can be made watertight and fire stopped. Sleeve sizes must be as required by NFPA 13 and 14 for Earthquake Protection.

2.17 SIGNS

A. Valve signs must indicate purpose and system of each control, test, trim, and drain valve. Hydraulic information sign must meet requirements of NFPA 13 and 14.

2.18 PIPE ESCUTCHEONS

A. General: Provide solid, (not hinged or split type) pipe escutcheons as specified with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. Escutcheons must be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid cast brass or sheet brass escutcheons, solid pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturer: Chicago Specialty, Producers Specialty, Sanitary-Dash.

2.19 FIRE BARRIER PENETRATION SEALS

A. Provide seals for opening through fire-rated walls, floors, or ceiling used as passage for mechanical components such as piping or ductwork in accordance with the Contract Documents.
   1. Piping: Provide fire stopping material in accordance with Section 07 84 13.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test in accordance with NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 “Quality Assurance” Article.

B. Report test results promptly and in writing to OWNER Representative.

3.2 EARTHWORK

A. Refer to Section 31 23 33, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 FIRE DEPARTMENT CONNECTION INSTALLATIONS

A. Install fire department connections of types and features indicated in locations indicated.

B. Install ball drip valves at each check valve for fire department connection to mains and where indicated. Drain to floor drain.

3.5 CONNECTIONS

A. Connect to specialty valves, specialties, fire department connections, and accessories.

B. Connect water supplies to sprinkler systems. Include backflow preventers.

C. Electrical Connections: Power wiring is specified in Division 26.

D. Connect alarm devices to fire alarm system.

3.6 FIELD QUALITY CONTROL

A. Perform field acceptance tests of each fire protection system.
   1. Flush, test, and inspect sprinkler piping systems according to NFPA 13.

B. Replace piping system components that do not pass test procedures specified, and then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
   1. Report test results promptly and in writing to the OWNER Representative.
   2. Report test results promptly and in writing to authority having jurisdiction when required.

C. Report test results promptly and in writing to the OWNER Representative and authority having jurisdiction.

3.7 CLEANING

A. Clean dirt and debris from sprinklers. Replace sprinklers having paint other than factory finish with new sprinklers. Cleaning and reuse of painted sprinklers is prohibited.

3.8 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

3.9 STARTUP SERVICES

A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
   1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
   2. Verify that excess pressure pumps and accessories have been installed correctly and operate correctly.
   3. Verify that specified tests of piping are complete.
   4. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
   5. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
   6. Check that potable water supplies have correct type of backflow preventer.
   7. Check that fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
   8. Fill wet-pipe sprinkler systems with water.
   9. Energize circuits to electrical equipment and devices.
   10. Adjust operating controls and pressure settings.

3.10 DEMONSTRATION AND TRAINING

A. In accordance with Section 01 79 00, the Contractor must conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation, and maintenance of the fire protection systems. Training sessions must be scheduled by the OWNER Representative at a mutually agreeable time to the Contractor and the OWNER Representative.

B. Operating Instructions:
   1. Furnish three (3) copies of printed operating and maintenance instructions to the OWNER Representative, and adequately instruct the maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

C. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

D. Schedule demonstration with at least 7 days' advance notice.

E. Upon completion of the system it must be tested in the presence of the Authority Having Jurisdiction.

END OF SECTION 21 10 00

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SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Pipe, tube, and fittings
2. Miscellaneous piping materials/products.
3. Valves.
4. Piping specialties.
5. Pipe escutcheons.
6. Fabricated piping specialties.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME).
1. ASME B31.9-2014 - Building Services Piping.
2. ASME B16.20-2012 - Metallic Gaskets for Pipe Flanges; Ring-Joint, Spiral-Would, and Jacketed
3. ASME B16.21-2016 - Nonmetallic Flat Gaskets for Pipe Flanges.
4. ASME B16.10-2017 - Face-to-Face and End-to-End Dimensions of Valves.
5. ASME B16.34-2013 - Valves Flanged, Threaded and Welding End.

B. National Certified Pipe Welding Bureau (NCPWB) - Standard Procedure Specifications.

C. ASME SEC IX - ASME Boiler and Pressure Vessel Code - Section IX: Welding and Brazing Qualifications.

D. ANSI Standards.
1. ANSI B16.20.1-2012 - Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral-Wound, and Jacketed.

E. AWWA Standards
1. AWWA C111-2007 - Rubber - Gasket Joints for Ductile - Iron Pressure Pipe and Fittings.

F. MSS Compliance:
1. MSS SP-25-2008 - Marking System for Valves, Fittings, Flanges and Unions.
2. MSS SP-72-2010 - Ball Valves with Flanged or Butt-Welding Ends for General Service.
3. MSS SP-80-2013 - Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

A. “Piping” includes, in addition to pipe, all fittings, flanges, valves, hangers and other accessories related to such piping.

B. “Wiring” includes in addition to conductors, all raceway, conduit, fittings, boxes, switches, hangers and other accessories related to such wiring.

C. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings or embedded in construction.

D. "Exposed" means not installed underground or "concealed" as defined above.

E. "Provide" means to furnish and install.

1.4 SUBMITTALS

A. General
1. Comply with the requirements of Division 1 and the specific requirements of the Sections of Division 22.
2. Submit all similar equipment together as part of the same submittal. For example:
   a. All water heaters shall be contained in the same submittal.
   b. All pumps shall be contained in the same submittal.
3. Contractor shall review all submittals prepared by each supplier and mark all copies as acceptable to the Contractor. This acceptance shall signify that all required service connections are shown and in the proper location to meet the installation requirements and that the equipment can fit in the space allowed.
4. Do not order equipment until submittals have been reviewed and approved by the OWNER Representative.
5. Each item submitted shall be labeled or identified the same as on the drawings.
6. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what difference, if any, exists between the submitted item and the specified item. Failure to point out the differences will be considered cause for disapproval. The OWNER Representative will not assume any responsibility for differences concealed or otherwise not brought to their attention, and the Contractor will be required to correct any deficiencies or differences discovered at a later date, and assume responsibility for any delays, damage, and/or expenses incurred by others due to such action.
7. Brands or trade names are mentioned to set standards of quality only; use no substitute materials, however, unless approved in writing by the OWNER Representative. Approval of substitute materials does not relieve the Contractor of responsibility for providing a workable and functioning system as specified.
8. Submittals will be checked for general conformance with the design concept but acceptance by the OWNER Representative in no manner is meant to verify that dimensions, quantities, or location of services are as necessary to meet the job requirements. This remains the responsibility of the Contractor.

B. Shop Drawings
1. General: Prepare and submit plans, sections, details and diagrams to required scales for specified areas. Drawings shall be coordinated, dimensioned, indicate equipment and piping in relation to architectural and structural features as well as other building systems. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, etc.
2. Required Drawings: Prepare and submit drawings for all areas and all plumbing work. Scale shall be minimum 3/8" = 1'-0" in mechanical rooms, fan rooms, and mechanical areas, and minimum 1/4" = 1'-0" elsewhere.

C. Coordination Drawings

1. General: Coordination drawings are defined as “shop drawings” which also indicate, on the same drawings, the major utilities of all other trades. “Coordination drawings” shall indicate location and elevations of structural slabs and beams, architectural elements, domestic water piping, plumbing vents, sanitary drains, storm drains, fire protection piping, lighting fixtures, electrical conduits (2-inch and larger), ductwork, penetrations of walls and roof, fire dampers, fire/smoke dampers, automatic dampers, terminal boxes, air outlets, access panels, ceiling mounted equipment and controls, gas piping, flues, fans, air handling equipment, etc.
2. Submit coordination drawings for the following:
   a. Entire housing building.
   b. Other areas for which space is limited.
3. It is the intent of the coordination drawings to ensure coordination of all major utilities, prior to the start of installation. This is a substantial effort which will require careful and detailed coordination and planning to ensure appropriate information is available, from all trades, in a timely manner. The coordination drawing effort shall be integrated into the project schedule and monitored to ensure conformance.
4. Conflicts between trades, which cannot be resolved through generally accepted practice of coordination between trades, shall be clouded on the coordination drawings and an appropriate description of the problem noted for review by the OWNER Representative.
5. Nonconforming M/E work installed within designated coordination areas is subject to removal and replacement by installing contractor at no additional cost to OWNER.
6. Coordination drawings shall be signed and dated by individual trade constructors. By act of signature and submittal of singular combined coordination drawings, each trade contractor acknowledges coordination of their portion of the Work with all other plumbing, mechanical, electrical, architectural, and structural work contractors.

D. Product Data
1. General: Manufacturer’s specifications, data sheets, certified drawings, and installation instructions. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, location and size of field connections, and accessories. Include certified drawings on major equipment such as boilers, water chillers, cooling towers, controls, pumps, and tanks.
2. Motors: Submit manufacturer’s name, type, RPM, HP (KW), full load amps, efficiency, and power factor.
3. Part Load Performance: Submit equipment data to indicate performance characteristics throughout ranges of possible load conditions.
4. Include operating weight and location of center of gravity of each item of equipment in manufacturer’s cut sheet for purposes of seismic calculation.
5. Pipes and Pipe Fittings: Submit schedule showing pipe material data, sizes, fitting valve type k factor, working pressure for each service.
6. Submit valve schedule showing manufacturer’s figure number, size, location, and valve features for each required valve.
7. Submit schedule showing manufacturer’s figure number, size, location, and features for each required piping specialty.
   a. Strainers: include pressure drop or chart for each type and size.
   b. Meters and gauges: include scale range for each service.

E. Test Reports
1. Manufacturer’s Tests
   a. Factory Tests: As specified for specific equipment.

b. Field Tests: As specified.

2. System Pressure Tests: As specified under "Testing" article. Test log of pressure tests on each system. Indicate date of test, scope of test, test pressure, duration, and observers.

F. Certification
1. Seismic Restraints: As specified under Section 22 05 29 and 22 05 48.
2. Welding Certificates.
3. Brazing Certificates.

G. Operating and Maintenance Manuals: Include, but not limited to, the following:
1. List of all equipment with Manufacturer's name, model number, and local representative, service facilities and normal channel of supply for each item. Include phone number and address of service facilities
2. System Description: Description of start-up, operating, and shutdown procedures.
3. Controls: Diagrams and description of operation sequence of each system.
4. Equipment: Manufacturer's brochures, ratings, certified shop drawings, lubrication charts and data, parts lists with part numbers, and belt and sheave data. Mark each sheet with equipment identification number and actual installed condition.
5. Materials and Accessories: Manufacturer's brochures parts lists with part numbers and lubrication data where applicable. Mark each sheet with equipment identification number or system and location of installation; and to specifically identify which options are provided (in case where data sheet shows multiple options).
6. Certificate of factory tests, field tests and code compliance as specified.
7. Wiring and controls schematics.
8. Trouble shooting directions.
9. Maintenance procedures and frequencies.
10. Description of special tools.
11. Copies of warranties.
12. Safety precautions.
13. Emergency contingencies.

H. Record Documents
1. Comply with the Conditions of the Contract and the requirements of Section 22 05 53.
2. Indicate mains and branches of piping systems, with valves and control devices located and numbered per valve schedule, concealed unions located, and with items requiring maintenance located (i.e. traps, strainers, expansion compensators, vents, etc.). Indicate actual inverts and horizontal locations of underground piping.
3. Indicate equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Identify approved substitutions, Contract Modifications, and actual equipment and materials installed.

I. Samples: When specified under applicable Sections.

1.5 QUALITY ASSURANCE

A. Perform all work in accordance with following rules (codes, standards and regulations):
1. Codes
a. California Building Code, Latest Edition: CBC
b. California Fire Code, Latest Edition: CFC
c. California Electrical Code, Latest Edition: CEC

d. California Plumbing Code, Latest Edition: CPC
e. California Mechanical Code, Latest Edition: CMC
f. California Occupational Safety Health Act: OSHA
g. California Code of Regulations: CCR
h. CCR Title 24 California Energy Code: CEC
i. Applicable Local Codes and Ordinances.

2. Standards
   a. Air Conditioning and Refrigeration Institute: ARI
   b. Air Movement and Control Association, Inc.: AMCA
   c. Canadian Gas Association: CGA
   d. American National Standards Institute: ANSI
   e. American Society of Heating, Refrigeration, and Air Conditioning Engineers: ASHRAE
   f. American Society of Mechanical Engineers: ASME
   g. American Society of Plumbing Engineers: ASPE
   h. American Society of Testing and Materials: ASTM
   i. American Water Works Association: AWWA
   j. American Welding Society: AWS
   k. Associated Air Balance Council: AABC
   l. Factory Mutual: FM
   m. International Association of Plumbing and Mechanical Officials: IAPMO
   n. Institute of Boiler and Radiator Manufacturers: IBR
   o. Manufacturer's Standardization Society of the Valves and Fittings Industry: MSS
   p. National Electrical Manufacturers Association: NEMA
   q. National Electrical Testing Association: NETA
   r. National Environmental Balancing Bureau: NEBB
   s. National Fire Protection Association: NFPA
   t. Plumbing and Piping Industry Council: PPIC
   u. Sheet Metal and Air Conditioning Contractors National Association, Inc.: SMACNA
   v. Underwriters' Laboratories: UL
3. Regulations
   a. California State Fire Marshal: CSFM
   b. California State Department of Public Health: CSDPH
   c. Safety Orders of Division of Industrial Safety: SODIS
   d. TIER 1: Energy Standard for State Buildings: TIER 1
4. Where standards of Contract Documents for materials and/or workmanship are higher than those of applicable rules, Contract Documents shall take precedence; otherwise the rules shall govern.
5. Nothing in the Contract Documents is to be interpreted as permitting the Work not conforming to the rules.
6. Should there be any direct conflict between the rules and the Contract Documents, the rules shall govern.
7. Charges for all materials and labor required for the compliance with rules and regulations shall be included in the Contract Price.

B. Certifications: Provide proof of code compliance for equipment as follows:
1. Gas Fired Equipment and Safety Devices: Per applicable standards and bear label of CGA.
   a. Fuel-burning heating appliances shall bear permanent and legible factory-applied nameplate on which shall appear: manufacturer's name; approved fuel input rating,

expressed in Btu/hr.; model and serial numbers; instructions for lighting, operation, and shutdown; type fuel approved for use; and symbol of approved agency certifying compliance of equipment with recognized standards.

2. Electrical Equipment and Safety Devices: Per applicable standards of NEC; UL listed or classified.
3. Pressure Vessels and Pressure Safety Devices: Per applicable standards and bear label of ASME.
4. Energy Conservation: Comply with applicable codes. Provide equipment and materials certified by manufacturer per California energy code as applicable.
5. Equipment: Provide UL listed or classified equipment where required by code officials. Verify such requirements.

C. Repair or replace, to the satisfaction of the OWNER, any damage to Work of this Section and damage caused by Work of this Section.

D. Workmanship shall be first class throughout and performed only by competent and experienced workmen in a manner satisfactory to the OWNER. Constant supervision of the Work, either by the Contractor or his competent representative, shall be maintained.

E. Work shall be installed so as not to delay the progress of construction and shall be properly coordinated with other trades.

F. Use only new materials in perfect condition. Inspect all materials upon arrival at job site and immediately remove defective items from site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.7 SUBSTITUTIONS

A. General
1. Base manufacturer is indicated in equipment schedules.
2. In Specification, additional acceptable manufacturer(s) may be indicated.
3. Other manufacturers, materials, or methods shall not be used unless approved in writing by the OWNER Representative.
4. The burden of proof as to the equality of any proposed substitute manufacturer, material**,** or method shall be upon the Contractor.
5. The OWNER Representative's decision shall be final.

B. Requests for substitution review and acceptance shall be accomplished by table of comparison listing pertinent features of both specified and proposed materials, such as materials of construction, performance, dimensions, weights, replacement or maintenance

access, motor type, horsepower, voltage, phase, service factor. Review of proposed substitutions will not be made until receipt of satisfactory comparison tabulation.

C. Submittal of substitutions shall be limited to one proposal for each type or kind of item, unless otherwise permitted by the OWNER Representative. If first proposed product submittal is rejected, Contractor shall then submit the first-named or scheduled product.

D. Contractor shall be responsible for all costs and coordination due to the substitution, such as impacts on electrical requirements, weight, openings in slabs and roofs, structural framing, housekeeping pad size, etc.

1.8 JOB CONDITIONS

A. Cause as little interference or interruption of existing utilities and services as possible. Schedule Work which will cause interference or interruption in advance with Construction Manager.

B. Examine Contract Documents to determine how other Work will affect execution of plumbing Work.

C. Determine and verify locations of all existing utilities.

D. Arrange for, coordinate, and pay costs incidental to providing utility company services indicated.

E. Establish lines and levels for each system and coordinate with other systems to prevent conflicts and maintain proper clearances and accessibility.

PART 2 PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping sections for pipe, tube, fittings materials joining methods. Comply with governing regulations.

2.2 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Provide welding materials to comply with installation requirements.
1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

2.3 VALVES

A. General: Refer to Section 22 05 23.

2.4 PIPING SPECIALITIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for

each service or, if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Dielectric Unions and Flanges
   1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion. Pressure rating equal to or greater than that of nearby valves.
   2. Manufacturers
      a. B & K Industries, Inc.
      b. Capital Mfg. Co.; Div. of Harsco Corp.
      c. Eclipse, Inc.
      d. Victaulic/Clearflow.

2.5 PIPE ESCUTCHEONS

A. General: Provide solid (not split-hinged) pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. All escutcheons shall be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid brass or solid sheet brass pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturers
   1. Chicago Specialty.
   2. Producers Specialty.
   3. Sanitary-Dash.

2.6 FIRE BARRIER PENETRATION SEALS

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for plumbing components such as piping.
   1. Piping: Provide fire stopping material as specified in Section 07 84 00.

2.7 FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:
   1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges:
      a. 3-inch and smaller: 0.040-inch/20 gauge thick.
      b. 4 to 6-inch: 0.064-inch/16 gauge thick.
      c. Over 6-inch: 0.079-inch/14 gauge thick.
   2. Steel Pipe: See Section "Mechanical Sleeve Seals".

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

D. Electrical Equipment Spaces: Do not run piping through transformer vaults, electrical rooms and other electrical or electronic equipment spaces and enclosures, unless piping or ductwork is for equipment serving that electrical space.

E. Comply with ASME B 31.1.

F. Pressures: Do not install piping, valves or piping specialties where exposed to system pressures greater than their rated working pressures.

G. Sloping, Air Venting and Draining:
1. Slope piping as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in direction of flow as follows:

Service	Inclination	Min. Slope
Cooling Coil Condensate Drain	Down	1/8” per foot (1-percent)

H. Install piping free of sags and bends. Support requirements are specified in Section 22 05 29.

I. Fittings
1. Provide standard, manufactured fittings in all cases. Field fabricated fittings are prohibited. Bushings are prohibited on pressure piping.
2. Weld-O-Lets and Thread-O-Lets may be used for non-galvanized steel piping if main pipe size is at least three standard pipe sizes larger than branch pipe, e.g. 2-inch main and 1-inch branch.

3. Provide insulating couplings at connections of ferrous piping to non-ferrous piping.

3.2 INSTALLATION OF VALVES

A. General: Except as otherwise indicated, comply with the following requirements:
   1. Install valves where required for proper operation and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
   2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

D. Fluid Control: Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ASME B31.9. Where throttling is indicated or recognized as principal reason for valve, install globe valves.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surfaces.

B. Dielectric Unions and Flanges: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

C. Fire Barrier Penetration Seals: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

3.4 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs.
   1. Do not install sleeves through structural members, except as detailed on Drawings, or as reviewed by the OWNER Representative.
   2. Install sleeves accurately centered on pipe runs.
   3. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run.
   4. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation.
   5. Pack 100 percent of annular space between sleeve and pipe or pipe insulation. Provide acoustical sealant at each end of pipe sleeve to seal packing in place.
      a. At fire-rated walls, partitions, floors, roofs, and ceilings: Packing shall be through-penetration firestop.

b. At non-fire-rated walls, partitions, floors, roofs, and ceilings: Packing shall be fiberglass insulation, with density of 1.5 pcf.

6. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves.
7. Extend floor sleeves 1 inch above level floor finish.
8. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
9. Provide temporary closure to prevent concrete and other materials from entering sleeves.

B. Type of Sleeves
1. Install sheet-metal sleeves at walls and partitions.
2. Install schedule 40 pipe sleeves in concrete slabs.
3. Install mechanical sleeve seals at exterior penetrations; below grade, and at slabs-on-grade.

C. Mechanical Sleeve Seals: Install in accordance with the manufacture's instructions.

3.5 PIPING EXPANSION PROVISIONS

A. General: Install domestic hot water piping with at least four elbows or tees at following locations.
1. Between piping mains and risers.
2. Between equipment and pump or tank.
3. Between piping main and equipment.

B. Expansion Loops: Fabricate expansion loops as indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Provide pipe anchor and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.
1. At Contractor's option, pipe anchors may be insulated lugged anchors; Pipe Shields, Inc.; Model #C4000 Series. Comply with requirements for insulated pipe supports in Section 22 05 29.
2. At Contractor's option, pipe guides may be guided insulated pipe supports; Pipe Shields, Inc.; Model #B3000 or B7000 Series. Comply with requirements for insulated pipe supports in Section 22 05 29.

3.6 INSTALLATION OF EQUIPMENT AND DEVICES

A. Install all equipment in accord with manufacturer's recommendations and in accordance with the equipment's listing (if applicable).

B. Access
1. Install all equipment and devices to permit easy access for maintenance.
2. Maintain easy access to all equipment and devices installed as part of Division 22 Work, including but not limited to, motors, drives, valves, actuators, etc.
3. Proper access shall include:
   a. Valves may be operated.
   b. Control devices may be adjusted.
   c. Equipment access panels may be opened.
   d. Normal maintenance work such as lubrication of bearings, etc., may be performed readily within arm's reach of access opening.
4. Relocate items which interfere with access.

5. When possible, install Work in accessible locations to avoid the need for access panels.
6. Provide access panels in ceilings, partitions, enclosures, etc. as required in order to achieve easy access to all equipment and devices provided or installed under Division 22 Work. Many access panel locations may be indicated on the Drawings. Provide additional access panels as required.
   a. For non-security walls, partitions, ceilings, enclosures, etc.: Provide non-security access panels as Work of Division 22. Requirements for access doors/panels are specified in Section 08 31 13.
   b. For security walls, partitions, ceilings, enclosures, etc.: Provide security access panels as Work of Division 22. Requirements for security access panels are specified in Section 08 31 13.
7. Coordinate with the OWNER Representative to achieve acceptable locations of access panels.
8. Coordinate all access panel locations with other trades and the Contractor.
9. Where possible, avoid locating access panels in secure areas.
10. Provide stainless steel access panels in areas subject to moisture.

C. Provide all necessary anchoring devices and supports.
   1. Use structural supports suitable for equipment, or as indicated.
   2. Check loadings and dimensions of equipment with shop drawings.
   3. Do not cut or weld to building structural members, unless specifically indicated.
   4. Provide all required equipment supports, including those not detailed on architectural and mechanical Drawings.
   5. Comply with Section 22 05 29 and 22 05 48.

D. Verify that equipment will fit support layouts indicated.
   1. Where substitute equipment is used, revise indicated supports to fit, at no additional cost to the OWNER.

E. Coordinate size and location of roof penetrations, floor penetrations, and wall openings with Work of other Sections.

F. Install rain hoods and metal counter flashings as indicated and as required to make all penetrations of plumbing work through walls and roofs, water and weather-tight. Furnish all clamps, waterproofing material and labor necessary.

G. Install floor mounted equipment on 6-inch high concrete pad, 6 inches larger on each side than base of unit, unless otherwise specified, indicated, or equipment manufacturer's recommendation calls for. Coordinate size and location of equipment pads and curbs with Work of other Sections.

H. In areas other than mechanical rooms, do not install piping, or equipment in exposed manner unless indicated otherwise.

3.7 ADJUSTING AND CLEANING OF VALVES

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Valve Identification: Tag each valve in accordance with Section 22 05 53.

3.8 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush clean interior of piping. Upon completion of flushing, completely drain systems at low points; remove, clean and replace strainer baskets and refill systems. Inspect each run of each system for completion of joints, supports and accessory items.
   1. Inspect pressure piping in accordance with procedures of ASME B31.1.

END OF SECTION 22 05 00

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SECTION 22 05 10 - BASIC PIPING INSTALLATION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basic requirements to furnish and install site piping.
2. Special tools.
3. Tape wrap.
4. Heat Shrink Wrap.
5. Pipe locating wire.
6. Closure sections.
7. Joint lubricant.
8. Feeler gauge.
9. Couplings.

1.2 REFERENCES

A. ANSI/NSF 60 - Standard for Drinking Water Treatment and Chemicals - Health Effects.

B. AWWA/ANSI C104/A21.4-90 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

C. AWWA/ANSI C110/A21.10-87 - Ductile-Iron and Gray-Iron Fittings for Water.

D. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch (100 mm through 300 mm) for Water Transmission and Distribution.

E. AWWA C210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

F. AWWA C651 - Disinfecting Water Mains.

G. NFPA 25 - Standards for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

1.3 DESCRIPTION

A. Provide all materials as required that will result, upon completion, in a functioning system in compliance with performance requirements specified, and any modifications resulting from reviewed shop and field coordination drawings.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Group shop drawings and product data of related systems, products, and accessories in a single complete submittal.

C. Submit complete data on pipe, fittings, linings, coatings, and any manufacturer's installation instructions for pipelines assembled in the field from standard pieces.

D. Prior to fabricating, purchase, or laying of any onsite pipe, or conduit, submit an electronic three-dimensional CAD (Land Desktop 2004) formatted coordination model of all existing and proposed underground pipe and conduit routings showing how contractor will route pressure pipelines and electrical conduits above or below gravity sewers and storm drain pipeline. Pipes and conduits shall be modeled to scale as three-dimensional surfaces, color-coded or otherwise identified as to type of utility. Utilities shall be placed in the model to true horizontal and vertical scale using project datum and layout coordinates. Contractor will be provided a DXF conversion of three-dimensional finish contour grading, and a two-dimensional line string model of site utilities as shown on the drawings. Line string DXF model has no diameter associated with individual utilities and contractor is to verify horizontal and vertical point of connection with individual buildings. Submit Certification of Compliance that utilities will be installed in accordance with approved utility coordination model unless otherwise directed. Maintain correct as-built conditions on coordination model. Submit as-built copy of model to OWNER Representative prior to project closeout.

E. Color, DVD, log sheets and written report detailing CCTV inspection of gravity pipelines.

1.5 REGULATORY REQUIREMENTS

A. Fire Protection: Conform to National Fire Protection Association.

B. Plumbing: Conform to 2016 CPC with California Amendments, 2016 California Plumbing Code.

C. Mechanical: Conform to 2016 CMC with California Amendments, 2016 California Mechanical Code.

D. Seismic: Conform to Chapter 23 of CCR Title 24.

E. Structural: Conform to 2016 IBC with California Amendments, 2016 California Building Code.

F. Electrical: Conform to 2016 NEC with California Amendments, 2016 California Electrical Code.

G. G. Fire: Conform to 2016 IFC with California Amendments, 2016 California Fire Code.

1.6 PROJECT/SITE CONDITIONS

A. Install work at locations shown on Drawings. If prevented by project conditions, prepare drawings showing proposed rearrangement of work. Include changes to Work specified in other sections. Obtain permission of OWNER Representative before proceeding with rearrangement.

B. Examine related work and surface before starting work on any section
1. Report to OWNER Representative, in writing, conditions which will prevent proper provision of this work.

2. Beginning work of any section without reporting unsuitable conditions to OWNER Representative constitutes acceptance of conditions.
3. Cause as little interference or interruption of existing utilities and services as possible. Notify OWNER Representative of any interruption.
4. Keep roads clear of materials and debris.

1.7 PRODUCT STORAGE AND PROTECTION

A. Storage
1. Exercise care in handling and storing of materials and equipment to avoid damage.
2. Store materials and equipment onsite in enclosures or under protective coverings.
3. Do not store materials and equipment directly on the ground.
4. Store equipment containing electrical motors, controls, and wiring in indoor, heated, clean, dry locations.

B. Protection
1. Protect all work and materials and equipment against loss or damage.
2. Close all pipe openings with caps or plugs.
3. Clean and deliver all work and equipment in an unblemished, new conditions.

1.8 FIELD QUALITY CONTROL

A. Repair or replace defective or damaged work, as directed by OWNER Representative.

B. Perform indicated tests to demonstrate satisfactory workmanship, operation, and performance.
1. Conduct tests in presence of OWNER Representative and, if requested, inspectors of agencies having jurisdiction, including local State Fire Marshall Representative.
2. Arrange date of tests in advance with OWNER Representative, manufacturer, and installer.
3. Give all inspectors minimum of 48 hours notice.
4. Furnish or arrange for use of electrical energy, steam, water, air, oxygen, or gas required for tests.

C. Repair or replace equipment and systems damaged, found inoperative, or defective, and continue remedial measures and retests until satisfactory results are obtained.

1.9 DRAWINGS

A. Drawings in general are diagrammatic and indicate sizes and locations only. Detailed connections to equipment and methods of installation for a complete installation are not shown.

B. Scaled dimensions shall be considered approximate.

C. Before proceeding with work check and verify dimensions required for a complete operating system.

1.10 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by OWNER Representative.

B. Advise OWNER Representative that work is ready for review at following times
   1. Prior to backfilling buried work.
   2. Prior to concealment of work in walls and above ceilings.
   3. When all requirements of contract have been completed.

C. Neither backfill nor conceal work without consent of OWNER Representative.

1.11 AS-BUILT DRAWINGS

A. Contractor to maintain current As-Built Drawings and provide same to OWNER Representative at close of construction.

B. Include all change orders, field changes, adjustments, substitutions and deletions.

C. Show sizes, invert elevations, and location of underground piping and related work.

1.12 POINT OF MANUFACTURE

A. OWNER Representative shall have free access to those parts of the manufacturer's plant that are involved in work performed under this Specification. The manufacturer shall afford the inspector, without charge, all reasonable facilities for determining whether the pipe or appurtenances meet the requirements of this Specification.

B. Inspection by OWNER Representative shall not relieve contractor of responsibility to furnish material conforming in all respects to the requirements of this specification.

C. If plant inspection and/or testing is requested by OWNER Representative, manufacturer shall notify OWNER Representative at least 72 hours in advance of date, time, and place of product testing.

PART 2 PRODUCTS

2.1 SPECIAL TOOLS

A. Furnish to OWNER Representative at completion of work:
   1. One set of any special tools required to operate, adjust, dismantle, or repair equipment furnished under any section of this Division.
   2. "Special Tools": Those not normally found in possession of mechanics or maintenance personnel.

2.2 TAPE WRAP

A. Tape Wrap: 15 mil, butyl rubber adhesive, polyethylene-backed tape as produced by Polyken Division of the Kendall Company, Boston, MA; Royston Laboratories, Inc., Pittsburg, PA.

2.3 HEAT SHRINK WRAP

A. Heat Shrink Wrap Pipe Joints: Use Raychem or Canuso of appropriate size and shape for flexible couplings and flange joints.

2.4 PIPE LOCATING WIRE AND MARKER

A. Pipe Locating Wire: Bare AWG No. 10, soft drawn, single-strand copper wire.

B. Provide at least six mil PVC electrical tape insulation around wire where adjacent to metal pipe, valves, and in all valve boxes.

C. Pipe marker shall be internal with locating wire color coded for use with different utility pipe systems, and marked with the utility tape every 24 inches. Provide 4 mil thick, 4-inch wide polyethylene marker.

2.5 CLOSURE SECTIONS

A. Furnish and install all necessary closures. Closure sections shall consist of one or more flexible couplings and plain-end pipe of lengths required to effect the closure. Pipe and couplings for closure sections shall conform to the pipe and flexible couplings specified for the principal parts of the pipeline.

2.6 JOINT LUBRICANT

A. Furnish joint lubricant with the pipes as recommended by the pipe manufacturer.

B. Lubricant for Water Pipes: Water-soluble, nontoxic, vegetable soap compound conforming to United States Pharmacopeia No. P39.

2.7 FLEXIBLE COUPLINGS

A. Flexible Couplings for Use With Steel Pipe: Dresser, Style 38; Smith Blair, Style 411. Use transition coupling for connecting steel pipe to PVC pipe, material shall be equal to couplings used for steel pipe, Protecting coat couplings.

B. Flexible Couplings for Use With Ductile Iron Pipe or PVC With Ductile Iron Pipe Sizes: Dresser, Style 38, 40, or 138; Smith Blair, Style 411 or 431. Protecting coat couplings.

C. Bolts and Nuts for Exposed Conditions: Zinc-coated. Bolts, nuts and washers for buried service shall be Type 304 stainless steel.

D. Middle rings and followers shall be fusion epoxy lined and coated.

2.8 TRANSITION COUPLINGS

A. Transition couplings used to connect pipes with small differences in outside diameter shall be Dresser, Style 162; Smith Blair, Style 413 Protecting coat couplings.

B. Bolts, nuts, and middle rings shall be as specified for flexible couplings.

C. Middle rings and followers shall be fusion epoxy lined and coated (System 29, Section 09 96 00).

2.9 THRUST TIES

A. Provide thrust ties where shown and where required to restrain the force developed by 1 1/2 times the operating pressures specified.
   1. Ductile Iron Pipe: Attach with socket clamps against a grooved joint coupling or flange.

B. Anchor studs perpendicular to longitudinal pipe axis are unacceptable.

C. Use type 304 stainless steel ties and hardware.

2.10 SERVICE SADDLES

A. Service Saddles: Smith Blair, Series 317; Romac, Model 202S. Service saddles shall be capable of withstanding 200 psi internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the saddle is installed. Taps shall have iron pipe threads. Saddles shall have malleable or ductile iron bodies and stainless steel straps, stainless steel hex nuts with washers, and neoprene seals. Service saddles shall be double-strap or wide band design. Saddles for PVC pipe shall be specifically designed for PVC pipe. Service saddles for use on PVC pipe shall provide full support around the circumference of the pipe. The saddle shall have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when the saddle is tightened. The service clamps shall not have lugs or other protrusions that will dig into the pipe when the saddle is tightened, a U-bolt type of strap that does not provide sufficient bearing area or a clamping arrangement that is not fully contoured to the outside diameter of the pipe. Saddles shall have a wedge or taper type gasket for a watertight installation.

2.11 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters for ductile iron piping shall be Smith Blair, Series 912; Dresser, Style 127.

B. Bolts, nuts, and protective coatings for steel components shall be as specified hereinbefore for flexible couplings.

C. Middle rings and followers shall be fusion epoxy lined and coated.

2.12 SLAB, FLOOR, ROOF, AND WALL PENETRATIONS

A. General: Provide ductile iron wall pipe with thrust collar unless otherwise specified or shown.

B. Ductile Iron Wall Pipe
   1. For penetrations through concrete walls.
   2. Diameter and Ends: Same as connecting ductile iron pipe.
   3. Thickness: Equal to or greater than remainder of pipe in line, pressure rating - 150 psi minimum.
   4. Fittings: In accordance with the applicable Detail Piping Specification.
   5. Provide taps for stud bolts in flanges set flush with wall face.
   6. Thrust Collars
      a. Provide for all wall pipes.
      b. Rated for thrust load developed at 250 psi.
      c. Safety Factor: Minimum of two.
      d. Material and Construction

1) Ductile iron or cast iron, cast integral with wall pipe wherever possible.
2) Fabricate by welded attachment of ductile iron thrust collar to pipe where casting impossible.
   a) Perform in pipe manufacturer's shop by qualified welders as specified herein.
   b) Welds: Electric arc welds of ductile iron with NI-55 or FC-55, nickel-iron-carbon weld rod.
   c) Continuously weld on each side all around.

C. Pipe Sleeves
1. Fabricate of 3/16 inch minimum thickness steel pipe.
2. Abovegrade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
3. Belowgrade or in Submerged or Damp Environments: Lined and coated after fabrication with System No. 2 as specified in Section 109 96 00 - High Performance.
4. Seep Ring
   a. Provide 3/16 inch minimum thickness center flange for water stoppage on sleeves in exterior or water-bearing walls.
   b. Outside Diameter: Three inches greater than wall pipe outside diameter.
   c. Continuously fillet weld on each side all around.
5. Existing Walls: Holes drilled with a rotary drill may be provided in lieu of sleeves.

D. Modular Mechanical Seal
1. Provide for existing wall penetrations by pipe sleeve.
2. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
3. Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates.
4. Size modular mechanical seals according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.

PART 3 EXECUTION

3.1 INSERTS, SLEEVES, AND EXPANSION PLUGS

A. Lay out work in advance of pouring concrete slabs or walls, and furnish and set inserts and sleeves necessary to complete the work.

B. Size inserts and required reinforcing rod to support the load applied.

C. Expansion plugs shall be selected for at least five times the load applied.

3.2 PREPARATION AND HANDLING

A. Pipe and fittings shall be inspected for dirt, damage, or defects prior to being installed or lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas patched with material similar to the original whole sections or replaced with new undamaged pipe. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installing.

B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Handle pipe in a manner which avoids damage to the pipe. Do not drop or dump pipe onto the ground or into trenches.

C. When cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer and approved by the OWNER Representative.

3.3 BURIED PIPE INSTALLATION

A. Laying Buried Pipe
1. General
a. Distribute material on the job no faster than it can be used to good advantage. Distribute no more than one day's supply of material in advance of laying, unless otherwise approved by the OWNER Representative.
b. Pipe shall be prepared as hereinbefore specified and shall be laid on the prepared pipe base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the OWNER Representative, trench conditions are unsuitable. Joints shall be made as herein specified for the respective types. Take all precautions necessary to prevent uplift and floating of the pipe prior to backfilling.
c. For gravity pipe, do not deviate more than 1 inch from line or 1/2 inch from grade unless otherwise approved. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
d. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and for pipe base when specified or indicated. Remove hard spots that would prevent a uniform bearing. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.
e. At the location of each joint, dig holes of ample dimensions in the bottom and sides of the trench to permit easy visual inspection of the entire joint.
f. When the pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed, and no trench water, animals, or foreign material shall be permitted to enter the pipe.
g. Where the pipe is connected to concrete structures, the connection shall be made as shown. If the connection is not shown, make connection such that a standard pipe joint is located no more than 24 inches from the structure.
h. Pipelines intended to be straight shall be so laid, and in no case shall deviation from a straight line exceed 0.10 foot for line and 0.10 foot for grade.
i. Pipelines laid on a curve may be deflected at the joints provided the deflections do not exceed 75 percent of maximum allowable as recommended by the pipe manufacturer.
j. Where horizontal or vertical curve alignments cannot be installed by joint deflection of standard pipe lengths, the Contractor may select from the following options
1) Use shorter pipe lengths and allowable joint deflection as specified.
2) Use standard or special fabricated bends.
3) In the case of PVC pipe inch deflection coupling.
k. For pressure pipe with indicated operating pressure greater than ten psi, provide thrust blocking at all joint bends or deflections of five degrees or greater.

l. Minimum pipe cover shall be 3 feet unless otherwise approved or shown on the plans. Pipe cover shall be varied as required to avoid high points in pressure pipelines and to avoid conflicts with other underground utilities or facilities. In no case shall non-metallic pipes or conduits that carry water have less than four feet of cover where they cross within 20 feet of either side of the double perimeter fences or other fences having a 24-inch deep concrete grade beam. All other pipes and conduits shall have a minimum of three feet of cover where they cross within 20 feet of either side of the double perimeter fence or other fences having a 24-inch deep concrete grade beam.

m. Lay pipe in accordance with approved laying plan.

2. Bell and Spigot Joint Pipe
   a. Join pipe in strict accordance with the manufacturer's recommendations. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutions will be permitted.
   b. Pipe laying shall proceed upgrade with spigot ends jointing in direction of flow. After a section of pipe has been lowered into the prepared trench, clean the end of the pipe to be joined, the inside of the joint, and the rubber ring immediately before joining the pipe.
   c. The joint gap inside of concrete piping 21 inches in diameter and smaller shall not exceed 3/8 inch in width. If the interior joints on 24 inch and larger pipe are greater than 3/8 inch, they shall be filled and sealed with premixed mortar conforming to ASTM C387 and troweled smooth on the inside surface.
   d. Buried ductile iron piping shall be installed with polyethylene bagging in accordance with ANSI/AWWA C105/A21.5-88. Installation shall be in accordance with Methods A and C of the indicated standard.
3. Mechanical Joint Pipe: Mechanical joint pipe varies slightly with different manufacturers. Install the particular pipe furnished in accordance with the particular manufacturer's recommendations, as approved by the OWNER Representative.
4. Solvent Welded Pipe: Solvent welded pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by manufacturer for the maximum temperature variation between time of solvent welding and final use.
5. Threaded Pipe
   a. Ream ends of cut and threaded metallic pipe.
   b. Apply joint lubricant approved for the intended use by the pipe manufacturer.
6. Fusion Bonded Pipe
   a. Fusion bonded pipe shall be joined using the manufacturers recommendations and recommended equipment.

B. Connecting Dissimilar Pipe Materials
   1. Connect dissimilar pipe materials by means of a flexible coupling. Install couplings in strict accordance with the manufacturer's recommendations.

3.4 INSTALLATION OF EXPOSED PIPING

A. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible on common size ranges.

B. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. Boltholes in all flanges shall straddle vertical centerline of pipes.

C. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the drawings.

D. Plastic flanges at any joint with a raised face shall be bolted up using a filler gasket. The filler gasket shall bear the bolt load uniformly and remove the flange moment from that part of the flange protruding beyond the outer edge of the raised face.

E. Pipe taps to the pipe barrel are unacceptable. Pipe tap connections to ductile iron piping shall only be made at a tapping boss of a fitting, valve body, or equipment casting.

F. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

G. Required straight runs of piping upstream and downstream of flow measuring devices shall be smooth.

H. Paint exposed piping in accordance with Section 09 96 00.

3.5 VENTS AND DRAINS

A. Vent the high points and drain the low points of all pressure pipelines, except gravity flow services, whether shown on the Drawings or not. Unless otherwise shown or directed, use 3/4-inch ball valves on pipelines 2-1/2 inch and larger and 1/2-inch ball valves on pipelines two inches and smaller.

3.6 INSULATED JOINTS

A. Install insulated joints between all connections of metallic pipe with dielectric coatings and metallic pipe with cement-mortar coatings.

B. Insulating joints shall be installed between copper pipe and any other metallic pipe.

C. Insulated joints shall be installed between ductile iron and any other type of metallic pipe or any existing ductile iron pipe unless otherwise shown. Insulated joints are not required between metallic pipe and nonmetallic pipe.

D. Do not insulate joints between steel pipe and iron valves or other appurtenances or vice versa.

E. Insulated joints may consist of flanges, flexible couplings, insulating unions, or other type of joints as specified in these specifications, unless otherwise shown or directed.

F. Cover and protect insulated joint during painting of aboveground adjacent piping to prevent short circuiting.

G. Install insulated joints at all connections of pipes with cathodic protection to equipment and buildings.

3.7 CORROSION PROTECTION OF ATMOSPHERIC EXPOSED ACCESSORIES

A. All atmospheric exposed surfaces of black and hot-dip galvanized steel, brass, copper and bronze piping components including, but not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners shall be painted in accordance with Section 09 96 00.

B. Pipe support systems shall be painted No. 70, light gray, as specified in ANSI Z53.1; Tnemec Co., Inc. No. 2050.

3.8 HEAT SHRINK WRAP

A. Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

3.9 WALL PIPES AND PIPE SLEEVES

A. Wall pipes and pipe sleeves embedded in concrete walls, floors, and on slabs shall be embedded as specified in Section 03 30 00 and as shown. Support all pipes embedded in concrete walls, floors, and slabs with formwork to prevent contact with the reinforcing steel.

3.10 INSTALLATION OF FLEXIBLE COUPLINGS, FLANGED COUPLINGS ADAPTERS, GROOVED JOINT COUPLINGS, AND SERVICE SADDLES

A. Clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. Flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively on opposite sides a little at a time until all bolts have a uniform tightness. Use torque-limiting wrenches.

3.11 PIPING SYSTEMS TESTING

A. General
   1. Prior to acceptance of work, test piping systems in the presence of the OWNER Representative and authorities having jurisdiction per respective and applicable governing codes and requirements of this section. All water piping shall be tested prior to backfilling per NFPA and the State Fire Marshall requirements.
   2. Provide necessary equipment and materials and make necessary test connections required to properly execute tests.
   3. Use only potable water for hydrostatic testing of potable water lines.
   4. Contractor may use [Site Name] water system as source for test water. Submit plan to protect water system from contamination prior to use.
   5. Remake leaking gasket joints with new gaskets and new flange bolting. Destroy old bolting. Where welded joints fail, submit proposed method of repair for approval by the OWNER Representative. Testing shall take place during steady state ambient temperature conditions.
   6. Other than standard piping flanges, plugs, caps and valves, use only commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. The safe test pressure rating of any plug shall be not less than two times the actual test pressure being applied. Do not use expandable elastomer plugs for piping which could

develop sufficient reactive force to cause damage to a structure, other piping, or cause moving of thrust or anchor provisions in case of blow-out.

7. Remove components from piping systems during testing whenever the component may sustain damage from the test pressure or test media. After completion of the test, reinstall the component and retest at the component pressure rating with suitable media.
8. Check system components such as valves for functional operation under system test pressure.
9. Duration of test shall be as specified per manufacturer.
10. Prepare and maintain records of piping systems tests. Record OWNER Representative and contractor personal responsibilities, dates, test gauge identification numbers, ambient temperature, pressure ranges, rates of pressure drop and leakage rates.
11. The connections between new underground piping and the existing shall not be separately tested. Pressure specified in governing code shall be maintained on the joint for not less than 30 minutes.
12. In the event testing demonstrates leakage rates in excess of specified limits, determine source(s) of leakage, repair or replace defective materials and workmanship and retest installation until compliance with specified requirements.
13. Take necessary precautions to vent the expansion force of compressed air trapped during high pressure hydrostatic pressure testing to preclude injury and damage. The OWNER Representative may require the removal of any system component including plugs and caps to ascertain whether the water has reached all parts of the system if purging or vent valves are not provided during construction.

B. Preparation and Execution
   1. Buried Pressure Piping: Conduct final acceptance tests on buried pressure piping that is to be hydrostatically tested after the trench has been completely backfilled, except water piping shall be tested prior to backfilling. The contractor may, if field conditions permit, partially backfill the trench and leave the joints open for inspection and conduct an initial test, except water pipe tests.

C. Hydrostatic Leak Tests
   1. Equipment: Furnish two graduated containers; two pressure gauges; one hydraulic force pump, and suitable hose and suction pipe as required.
   2. Buried Water Fire Suppression Water Piping.
      a. Water piping shall be tested in accordance with NFPA.
      b. Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least five days have elapsed after the thrust blocking is installed. If high-early-strength concrete is used for thrust blocking, the time may be reduced to two days. When testing cement-mortar lined piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the cement-mortar lining to absorb water.
      c. Expel all air from the piping system prior to testing and apply and maintain the specified test pressure by means of the hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the pressure test for two hours, reopening the isolation valve only as necessary to restore the test pressure. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately. This measurement represents the leakage, which is defined as the quantity of water necessary to maintain the specified test pressure for the duration

of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula.

1) $L=SD(P)^2/133,200$
2) In the above formula
3) L=Allowable leakage, in gallons per hour
4) S=Length of pipe tested, in feet
5) D=Nominal diameter of pipe, in inches
6) P=Test pressure during the leakage test, in pounds per square inch

d. Correct any leakage greater than the allowance determined under this formula.

e. Maximum test length shall be the shortest length that can be isolated by closing adjacent valves or the length between a valve and an end cap.

D. Gravity Sewers: Gravity sewers shall be air tested as follows:

1. Time of Testing: Test pipe after backfilling has been completed. The Contractor, at his option and expense, may make other earlier tests to ensure compliance with the tests specified herein.
2. Procedure
   a. After all plugs are in place and securely blocked, introduce air slowly into the pipe section to be tested until the internal air pressure reaches 5.0 pounds per square inch. Allow a minimum of two minutes for the air temperature to stabilize.
   b. Pipe and joints being air tested shall be considered satisfactory when tested at an average pressure of 3.0 pounds per square inch when (1) the total rate of air loss from the section being tested does not exceed 2.0 cubic feet per minute, or (2) the section of lines does not lose air at a rate greater than 0.0030 cubic foot per minute per square foot of internal pipe surface.

3.12 INTERIM CLEANING

A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, etc., within piping sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.13 FLUSHING

A. Following assembly and testing and prior to final acceptance, all potable water pipelines installed under this section shall be flushed with water and all accumulated construction debris and other foreign matter removed. Use only potable water for flushing potable water pipelines. Flushing velocities shall be a minimum of 2.5-feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the OWNER Representative. Accumulated debris shall be removed through drains two inches and larger or by dropping spools and valves.

3.14 DISINFECTION

A. Pipelines intended to carry potable water shall be disinfected before placing in service. Disinfecting procedures shall conform to AWWA C651-86 and ANSI/NSF 60, as hereinafter modified or expanded.

1. Complete flushing before disinfecting.
2. Disinfecting Mixture
   a. Disinfecting mixture shall be a chlorine-water solution having a free chlorine residual of 40 to 50 ppm. Prepare disinfecting mixture by injecting: (1) a liquid chlorine gas-water mixture; (2) dry chlorine gas; or (3) a calcium or sodium hypochlorite and water mixture into the pipeline at a measured rate while fresh water is allowed to flow through the pipeline. The combined mixture of fresh water and chlorine solution or gas shall be of the specified strength.
   b. Apply disinfecting mixture by means of a standard commercial solution feed chlorinating device. Dry chlorine gas shall be fed through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas or the gas itself must provide means for preventing the backflow of water into the chlorine cylinder.
   c. If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a one percent solution (10,000 ppm chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one percent solution. The following proportions of hypochlorite to water will be required.

Product	Quantity	Water
Calcium Hypochlorite[a] (65 - 70 percent C1)	1 pound	7.5 gallon
Sodium Hypochlorite[b] (5.25 percent C1)	1 gallon	4.25 gallon

[a]Comparable to commercial products known as HTH, Perchloron, and Pittchlor.
[b]Known as liquid laundry bleach, Clorox, Purex, etc.

3. Point of application: Inject disinfecting mixture into the pipeline to be treated at the beginning of the line through a valve and a suitable connection to the top of the pipeline. Clean water from the existing system or another source shall be controlled so as to flow slowly into the newly installed piping during the application of chlorine. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Use check valves if necessary.
4. Retention Period
   a. Treated water shall be retained in the pipeline long enough to destroy all nonspore-forming bacteria. With proper flushing and the specified solution strength, 24 hours is adequate. At the end of the retention period, the disinfecting mixture shall have a strength of at least 10 ppm of chlorine.
   b. Operate all valves, hydrants, and other appurtenances during disinfection to assure that the disinfecting mixture is dispersed into all parts of the line, including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.
   c. Do not place concentrated quantities of commercial disinfectant in the line before it is filled with water.

d. After chlorination, flush the water from the pipeline until the water through the line is equal chemically and bacteriologically to the permanent source of supply.

5. Dispose of disinfecting water in an acceptable manner that will protect receiving waters from harmful or toxic concentrations of chlorine. The disinfecting water shall be retained onsite in open detention basins or other methods approved by the OWNER Representative.

3.15 VALVES

A. Install valves in accordance with the manufacturer's recommendations. Operating stems shall be vertical unless otherwise indicated or approved by OWNER Representative.

3.16 LOCATING WIRE AND MARKER TAPE

A. Pipe locating wire shall be provided for the entire length of all pressure pipelines except for metallic piping.

B. Install locating wire by strapping to the pipe or tubing with PVC tape, polyethylene backed tape, or tie locks. Test pipe locating wire with pipe locator equipment prior to final acceptance of pipeline.

C. Stub the locating wire up inside each valve box. Sufficient excess length shall be provided at terminal connections to allow continuation of locating wire to the terminal connection.

D. Wire splices shall be made with compression fittings or soldering; wrapped with Tac-Tape, Aqua-Seal; and wrapped with electrical tape. Prevent bare copper wire from contacting metallic appurtenances including, but not limited to, pipe, buried valves, or fittings.

END OF SECTION 22 05 10

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Pipe hangers and supports.
2. Vertical piping clamps.
3. Hanger-rod attachments.
4. Building attachments.
5. Pipe shields.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP 90-2000, Guidelines on Terminology for Pipe Hangers and Supports.

1.3 SUBMITTALS

A. Submit in accordance with Division 01.

B. Shop Drawings: Sealed by a Professional Structural Engineer licensed in the State of California.
1. Support and Bracing Shop Drawings: Submit plans, sections, details, schedules and other information necessary to describe support hangers and bracing for all plumbing systems. Submittal shall indicate location and type of all hangers and supports. Each attachment to the building structure shall have vertical and horizontal point loads identified.
2. Shop drawings for each type of hanger and support, indicating dimensions weights, required clearances, and methods of component assembly.

C. Calculations: Sealed by a Professional Structural Engineer licensed in the State of California.
1. Prepare design drawings and calculations for support and seismic restraint of piping and equipment.

D. Product Data
1. Product data for products and materials indicated.
2. Manufacturer’s technical bulletins and installation/application instructions.
3. Material Safety Data Sheets (MSDS).
4. Manufacturer’s data (catalog cuts and data sheets), for each manufactured component including hangers, attachments, inserts, thermal shields anchors and guides, auxiliary framing and wall seals. Provide a project specific hanger and support schedule indicating all devices, manufacture and model, where used. Cross reference to product data and specification paragraph. Data shall demonstrate that components comply with Specifications.

E. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual in accordance with requirements of Division 1.

F. Certificates
   1. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

H. Qualification Data
   1. For manufacturer as specified in the "Quality Assurance" Article.

1.4 DESIGN REQUIREMENTS

A. Design and calculations for support and seismic bracing shall be performed under the direct supervision of and sealed by a Professional Structural Engineer licensed in the State of California and experienced in the design of this Work.

B. Where not fully called for in the Contract Documents, design of plumbing hangers and supports shall be the plumbing contractor's responsibility. Design shall conform to accepted engineering practice using a safety factor of 2-1/2.

C. Vibration Isolation: Comply with the requirements of Section 22 05 48.

D. Seismic Restraints: Comply with the seismic design criteria outlined in Section 22 05 48.

1.5 QUALITY ASSURANCE

A. Manufacturer's qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards
   1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
   2. Qualify welding processes and welding operators according to AWS D1.1.
      a. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
   3. Qualify welding processes and welding operators according to ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications.
   4. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
      a. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems
      b. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
   5. MSS Standard Compliance:
      a. Provide pipe hangers and supports of which materials design and manufacture comply with MSS SP-58. Select and apply pipe hangers and supports, complying with MSS SP-69.

b. Fabricate and install pipe Local and supports, complying with MSS SP-89.
c. Terminology used in this Section is defined in MSS SP-90.

1.6 COORDINATION

A. Coordinate resiliently supported Work with other trades to avoid rigid contact with the building. Inform other trades such as drywall, plastering, or electrical, to avoid any contact which would reduce the vibration isolation.

1.7 CONFLICTS AND DISCREPANCIES

A. Bring to the OWNER Representative's attention prior to installation any conflicts with other trades which will result in unavoidable contact to equipment, piping, etc., described herein, due to inadequate spaces, etc. Corrective work necessitated by conflicts after installation shall be at Contractor's expense.

B. Bring to the OWNER Representative's attention prior to installation any discrepancies between the Contract Documents and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective Work necessitated by discrepancies after installation shall be at Contractor's expense.

PART 2 PRODUCTS

2.1 GENERAL

A. Corrosion Resistance: Provide hot-dip galvanized steel, cadmium plating, or other approved corrosion resistant materials for exterior Work and for Work which will be subject to outdoor exposure during construction.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
1. Superstrut, Gold Gal V.
2. B-Line Systems, lnc.
3. Fee & Mason Mfg.Co.; Div. Figgie International ITT Grinnel Corp

2.3 MANUFACTURED HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide felt-lined hangers and supports for copper piping systems in direct contact with copper piping components including galvanized coatings where installed for piping and equipment that will not have a field applied finish. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper piping.

B. Thermal-Hanger Shield Inserts: 100 psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Shield Insert shall cover entire circumference of pipe and be of length indicated by manufacturer for pipe size and thickness of insulation by CSS Pre-Insulated Supports.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated type, drive-pin attachments are not acceptable.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Adjustable Steel Clevises Hangers: MSS Type 1.

F. Yoke Type Pipe Clamps: MSS Type 2.

G. Steel Double Bolt Pipe Clamps: MSS Type 3.

H. Steel Pipe Clamps: MSS Type 4.

I. Pipe Hangers: MSS Type 5.

J. Adjustable Swivel Pipe Rings: MSS Type 6.

K. Adjustable Steel Bond Hangers: MSS Type 7.

L. Adjustable Band Hangers: MSS Type 9.

M. Adjustable Swivel Rings, Band Type: MSS Type 10.

N. Split Pipe Pings: MSS Type 11.

O. Extension Split Pipe Clamps: MSS Type 12.

P. U-Bolts: MSS Type 24.

Q. Clips: MSS Type 26.

R. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
1. Plate: Unguided type.
2. Plate: Guide type.
3. Plate: Hold-down Clamp type.

S. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange.

T. Makeshift, field devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42.

2.4 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical piping clamps complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to

suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide felt-lined or copper-plated clams for copper-piping systems.

B. For vertical mid-span supports of piping 4 inch and under, use Hubbard Enterprises/HOLDRITE Stout Brackets with Hubbard Enterprises/HOLDRITE Stout Clamps or two-hole pipe clamps (MSS Type 26).

C. Two-Bolt Riser Clamps: MSS Type 8.

D. Four-Bolt Riser Clamps: MSS Type 42.

2.5 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.6 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Powder-actuated fasteners are not acceptable.

B. Concrete Inserts
   1. Cast-in-Place Concrete Inserts: MSS Type 18.
   2. Post-Installed Anchors: Proprietary type, designed for intended uses, and ICC ESR evaluated.
      a. Manufacturers
         1) ITW Ramset/Red Head.
         2) Simpson.
         3) Hilti Co.

C. Top Beam C-Clamp: MSS Type 19.

D. Side Beam or Channel Clamps: MSS Type 20.

E. Center Beam Clamps: MSS Type 21.

F. Welded Beam Attachments: MSS Type 22.

G. C-Clamps: MS Type 23.

H. Top Beam Clamps: MSS Type 25.

I. Side Beam Clamps: MSS Type 27.

J. Steel Beam Clamps with Eye Nut: MSS Type 28.

K. Linked Steel Clamps with Eye Nut: MSS Type 29.

L. Malleable Beam Clamps: MSS Type 30.

M. Steel Brackets: One of the following for indicated loading:
   1. Light Duty: MSS Type 31.
   2. Medium Duty: MSS Type 32.
   3. Heavy Duty: MSS Type 33.

N. Side Beam Brackets: MSS Type 34.

O. Plate Lugs: MSS Type 57.

P. Horizontal Travelers: MSS Type 58.

Q. Powder-Actuated Fasteners: Not allowed.

2.7 INSULATED PIPE SUPPORTS (PIPE SHIELDS)

A. All insulated lines shall be protected at the point of support by insulated pipe supports provided and installed by the pipe erector.

B. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes:
   1. ASME B31.1, MSS SP-58, MSS SP-69, and MSS SP-89.

C. Manufacturers
   1. Pipe Shields Incorporated (PSI).
   2. Michigan.
   3. B-Line.

D. Insulated Pipe Supports
   1. Pipe supported on rod hangers PSI, Michigan, B-Line.
   2. Pipe supported on Flat Surfaces PSI, Michigan, B-Line.
   3. Anchors PSI, Michigan, B-Line.
   4. Riser Pipe Supports PSI, Michigan, B-Line.

E. Insulation
   1. 360-degree insulation, encased in 360-degree sheet metal shield.
   2. Provide assembly of same thickness as adjoining pipe insulation.
   3. Insulating Material:
      a. Cold Piping (below 50 degrees F): Urethane foam, 100 psi compressive strength.

b. Hot piping (above 50 degrees F): Calcium silicate, 100 psi compressive strength, treated with water repellent.

2.8 MISCELLANEOUS MATERIALS

A. Auxiliary Steel
1. Provide auxiliary structural steel as required for supports, anchors, guides, seismic restraints and vibration isolators.
2. All structural steel systems to be designed in accordance with AISC Steel Handbook.
3. All systems to be secured to building structure in a method acceptable to and approved by the OWNER Representative.
4. Steel Work: Fabricate neatly. Grind off excess burrs and welding spatter. Paint with rust inhibitive primer.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A36.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No.2). Mix at a ratio of 1.0 part cement to 2.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
1. Manufacturers
a. Hyspan.
b. Metraflex.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive the Work. Notify the OWNER Representative, in writing, of any conditions requiring corrective action.

B. If unsatisfactory conditions exist, do not commence the installation until such conditions have been corrected. Beginning of installation means acceptance of existing conditions.

3.2 GENERAL

A. Install devices in accordance with manufacturer's recommendations and approved shop drawings.

B. Support of pipe tubing and equipment shall be accomplished through means of engineered products specific to each application. Makeshift field devised methods will not be allowed.

C. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.3 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the Work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated Work, Installer shall meet at Project site with Contractor, Installer of each component of associated Work, Inspection and testing agency representatives (if any), Installers of other Work requiring coordination with Work of this Section and the OWNER Representative for purpose of reviewing material selections and procedures to be followed in performing the Work in compliance with requirements specified.

3.4 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69, or per schedules below, whichever is more severe. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.
1. For plumbing piping, support spacing shall be per California Plumbing Code (CPC).
2. For fire protection piping, support spacing shall be per code and NFPA 13.

B. Loading on Steel Beams
1. Do not place eccentric loads on steel beams for loads greater than 50 pounds.
2. For loads greater than 50 pounds, use attachments which create concentric loading.

C. Cast-in Place Concrete Inserts
1. Install before concrete is placed. Fasten inserts securely to forms.
2. Install with reinforcing bar through opening at top of insert or with steel plate to distribute load, as detailed on Drawings.
3. Maximum load per insert in slabs shall be 200 pounds, with a minimum spacing of 5 feet in any direction. For loads greater than 200 pounds, or where spacing cannot be maintained, make attachment to building structure or auxiliary steel, rather than to slab.

D. Post-Installed Concrete Anchors: Maximum tension load per insert shall not exceed ICC ESR published values.

E. Powder-Actuated Fasteners: Not allowed.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports of smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Install in accordance with Seismic Restraint manual Guidelines for Mechanical Systems (SMACNA).
1. Materials, design and type numbers per MSS-58.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire protection piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, felt-lined.

E. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.1 Power Piping Codes are not exceeded.

H. Insulated Piping: Comply with the following installation requirements:
   1. Provide insulated pipe support (pipe shield) at each support of insulated piping.
   2. Select model of insulated pipe support according to published recommendations of insulated pipe support manufacturer, based on pipe size, pipe material, fluid medium, fluid temperature, support spacing, and type of support.
   3. Submit tabulation showing proposed uses of insulated pipe supports for different applications.

I. Provide pipe supports on all DWV vertical piping penetrating floor slabs.

J. All hanger components shall be Superstrut Gold Galv.
   1. Vertical Piping: Superstrut C720 clamps attached to the pipe above each floor to rest on the floor. Provide copperplate on copper tubing. Provide additional support at base of cast iron risers. Provide intermediate support for vertical piping greater than 12 feet in length.
   2. Individually Suspended Piping: Superstrut J-Hanger or Clevis, complete with threaded rod. Copper pipe will be used in conjunction with felt lined hangers.

Pipe Size	Rod Size
2-inch and smaller	3/8 inch
2-1/2 to 3-1/2-inch	1/2 inch
4 to 5-inch	5/8 inch
6-inch	3/4 inch
8-inch and up	7/8 inch

   3. Provide 3/8 inch or support of PVC and CPVC and provide continuous support.
   4. Trapeze Suspension: Superstrut 1-5/8-inch width channel in accordance with manufacturers published load ratings. No deflection to exceed L/180 of a span.
   5. Trapeze Supporting Rods: Shall have a safety factor of 5; securely anchor to building structure.
   6. Pipe Straps: Superstrut isolate copper pipe with two layers of 2-inch wide 10 mil polyvinyl tape (Cush-A-Strip or Cush-A-Clamps). Where used for seismic support systems, provide Superstrut 702 or C708 series pipe straps.

K. Concrete Inserts: Superstrut C302 continuous insert or 452-TB spot insert. Do not use actuated fasteners for support of overhead piping unless approved by the OWNER Representative.
   1. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
   2. Install concrete inserts in new construction prior to placing concrete. Superstrut 452-TB, C745, or C302.
   3. Install post-installed concrete anchors after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

L. Support to Structure
   1. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the OWNER Representative.

M. Rubber Neoprene Pipe Isolators
   1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls as indicated on the Drawings.
   2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. [Superstrut] [S716] or [A716].

N. Pipe Hangers and Support Spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and space at or within following maximum limits. Note that spacing listed are recommended maximums; increased spacing requirements due to California Building Code requirements, CCR Title 24, or other regulations in force and applicable for this contract shall be adhered to.

Pipe Diameter	Steel Fluid	Steel Vapor	Copper Fluid
1/2 to 1-inch	6	8	6
1-1/4 to 1-1/2-inch	8	10	6
Over 2-inch	10	10	10

O. For cast iron soil piping.
   1. Support piping at every other joint for piping length of less than 4 feet.
   2. For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.
   3. Hanger shall not be installed on the coupling.
   4. Provide support at each horizontal branch connection.
   5. Provide Superstrut Seismic Manual Stamped OPA-0003 using Seismic Restraint Manual tables.

P. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

Q. Provide rigid insulation and a 12-inch long, 18-gauge galvanized sheet metal shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering or CSS Pre-Insulated Calcium Silicate Support.

R. Insulate copper tubing from ferrous materials and hangers with felt lined hangers.

S. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

T. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

3.6 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.7 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint and exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA1 requirements for touching up field-painted surfaces.
1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Section 09 90 00, Painting and Coding.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.8 INSPECTION AND INSTRUCTION

A. Obtain inspection and approval from the OWNER Representative of any installation to be covered or enclosed prior to such enclosure.

3.9 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Structural Engineer, licensed in the State of California, certifying compliance with Specifications.

END OF SECTION 22 05 29

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SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Seismic restraints.
2. Flexible Connectors.

1.2 REFERENCES

A. ASHRAE - Guide to Average Noise Criteria Curves.

1.3 SUBMITTALS

A. Submit in accordance with Division 01.

B. Shop Drawings: Sealed by a Professional Structural Engineer licensed in the State of California.
1. Welds or anchor bolt locations.
2. Reinforcing and template steels.
3. Number and locations of seismic restraints for each piece of equipment; specific details of restraints including anchor bolts for mountings and maximum load at each location.
4. Spring O.D., free operation, and solid height of springs and ratio of horizontal to vertical stiffness.
5. Number and location of vibration isolators for each piece of equipment including actual operating load for each vibration isolator.

C. Calculations: Sealed by a Professional Structural Engineer licensed in the State of California.
1. Prepare design drawings and calculations for each seismic restraint of piping and equipment.
2. Calculations shall substantiate seismic restraint capability to safely accept external forces without failure and maintain equipment in position.

D. Product Data
1. Product data for products and materials indicated.
2. Manufacturer’s technical bulletins and installation instructions.
3. Material Safety Data Sheets (MSDS).
4. Vibration isolation devices: Catalog cuts, isolation efficiencies and rated static deflections.

E. Manufacturer’s Installation Report as specified in the “Field Quality Control” Article.

1.4 DESIGN REQUIREMENTS

A. General
1. Provide seismic restraints for pipes and equipment, including pipes above roofs, supported from below in accordance with the requirements of the California Code of Regulations, Title 24, Parts 2, 3, 4, and 5.

2. Where designs are neither indicated nor referenced, submit such designs, together with supporting calculations.
3. Design shall be performed under the direct supervision of and sealed by a Professional Structural Engineer licensed in the State of California and experienced in the design of this Work.
4. Supplementary steel to be sized for maximum deflection of 0.08 inches at center span.

B. Seismic Restraint
1. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A.
2. Provide seismic restraints for pipes and equipment per CBC, CMC, and CPC, including pipes above roofs, supported from below.
3. Provide seismic restraint for pipe sizes covered by SMACNA:
   a. In equipment room.
   b. In shafts and in ceiling of occupied spaces.
4. Provide seismic restraint for floor mounted equipment weighing more than 400 pounds and wall mounted or suspended equipment weighing more than 20 pounds.
5. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.
6. Provide approved resilient restraining devices as required to prevent equipment and piping motion in excess of 1/4 inch.
7. Provide capability of safely accepting external forces without failures.
8. Do not short circuit vibration isolation systems or transmit objectionable vibration or noise.
9. Seismic restraint spacing shall be in accordance with specified hanger spacing.
10. Rigidly Supported Piping
    a. Where required for all systems, except sprinkler piping system, restrain per SMACNA seismic standards.
11. Flexibly Supported Piping
    a. Provide and locate restraints to allow normal operation of systems without transmitting vibrations to building structure.
    b. Locations of Restraints: Per SMACNA and Factory Mutual where applicable.
    c. Construction of Restraint: Steel cables, installed slack, may be used.
12. Isolate piping outside of shafts as follows:
    a. Water piping 1-1/4 inch and larger in mechanical equipment rooms: Within 50 feet or 100 pipe diameters whichever is smaller, of connected rotating equipment and pressure reducing stations.

C. Design Seismic Loads
1. Design components, support, and anchorage to resist seismic forces in accordance with CBC Chapter 16A.
2. Minimum Design Parameters
   a. Occupancy Category: III.
   b. Site Classification: D.
   c. Seismic Design Category: D.
   d. Importance Factor: I_P = [1.0] or [1.5].
   e. Spectral Acceleration: S_{DS} = [1.0] and S_{D1} = [0.7].

D. Design Wind Loads
1. Design structure to resist wind loads in accordance with CBC Chapter 16A.
2. Alternative Wind Design Procedure: IR 16-7.

3. Minimum Design Parameters
   a. Basic Wind speed: V = 85 mph.
   b. Exposure Category: C.
   c. Importance Factor: I = 1.15.

1.5 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. All items of a given type shall be the product of the same manufacturer.

C. Provide necessary design for avoidance of excessive noise and vibration in building due to operation of machinery or equipment, or due to interconnected piping or conduit.

D. Installation of all vibration isolation units, and associated hangers and bases, shall be under direct supervision of vibration isolation manufacturer's representative.

PART 2 PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Manufacturers
   1. Midland-Ross Superstrut.
   2. Pipe Shields, Inc.
   3. B-Line.

B. Restraint Types
   1. Type R-1: Provide directional seismic restraints with interlocking steel members restrained by replaceable, minimum 1/4-inch thick bridge bearing neoprene bushing, capable of rotation after installation to verify isolation system is out of contact with restraints. Incorporate minimum air gap of 1/8 inch in snubber design in all directions before contact is made between rigid and resilient surfaces.
   2. Type R-2: Restraints of all isolated suspended piping, ductwork and equipment using steel cables arranged to achieve required all-directional restraint and sized to resist seismic loads. Indicate proposed method of achieving sufficient slack to avoid short circuiting vibration isolators in submittal drawing.

C. General Requirements
   1. Provide seismic restraints for all vibration isolated equipment, ductwork and piping.
   2. Restrain supported and suspended equipment and piping by devices capable of restraint in all three mutually orthogonal directions.
   3. For suspended equipment, utilize stranded steel aircraft cable plus modifications to isolators to prevent excessive vertical motion.
   4. Seismic restraints must be installed and adjusted so equipment and piping vibration isolation is not degraded by utilization of restraints.

2.2 FLEXIBLE CONNECTORS

A. Manufacturers
   1. Mason Industries, Inc.

2. Amber Booth.

B. Neoprene Connectors
1. Use flexible EPDM connectors on equipment as indicated on drawings or on equipment schedule, manufactured of multiple layers of frictioned nylon cord with EPDM cover and liner. Do not use steel wire or rings as internal pressure reinforcement. Provide straight connectors with two spheres with a centered molded external ductile iron ring to maintain two spherical shapes. Two inch and smaller sizes may have threaded ends. Provide floating flanges with recess to lock bead wire in raised face EPDM flanges. Use tapered twin sphere connectors as described above where line size changes are required in straight piping runs.
2. Flanged equipment may be directly connected to neoprene elbows in size range 2-1/2 to 12 inches, if piping makes 90 degree turn and flanges are equal sized. Long radius reducing EPDM elbows may be used in place of steel or cast iron elbows at pump connections.
3. When pressure would cause connector to extend beyond its rated elongation, employ control rods using 1-1/2-inch thick bridge-bearing neoprene washer bushings designed for maximum loading of 1000 psi.
4. Provide twin sphere connectors with minimum rating of 250 psi at 170 degree F and 165 psi at 250 degree F. Provide elbows and reducing twin spheres with minimum pressure rating of 220 psi at 170 degree F and 145 psi at 250 degree F. Limit neoprene materials to 220 degree F. Certified safety factors shall be a nominal 4 to 1 with minimum acceptable test results of 3.6 to 1. Tests shall cover burst, flange leakage, extension without control rods and flange retention at 50 percent of burst pressure without control rods.
5. Include in submittals test reports by independent consultants showing minimum reduction of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

C. Flexible Stainless Steel Hose
1. Provide flexible stainless steel hose with stainless steel braid and carbon steel fittings. Provide flanged fittings for sizes 3-inch and larger, and make nipples for smaller sizes. Use bronze braided flexible hose with female sweat ends for copper lines. Install hoses on equipment side of shut-off valves horizontally and parallel to equipment shafts whenever possible. Flexible metal hose shall be Type BSS or BFF.

PART 3 EXECUTION

3.1 GENERAL

A. Isolate plumbing equipment from building structure by means of noise and vibration isolators.

B. Install isolators in accordance with manufacturer's written instructions and approved shop drawings.

C. Vibration isolators must not cause change of position of equipment or piping resulting in piping stresses or misalignment.

D. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system.

1. Loop electrical conduit connections to isolated equipment to allow free motion.

3.2 FIELD QUALITY CONTROL

A. Provide inspection by manufacturer's representative of all vibration isolating devices after installation of all devices.

B. Submit written report by manufacturer regarding installation error, improper selection of devices, and other faults that could affect performance of system. Include report on steps to properly complete isolation work.

END OF SECTION 22 05 48

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Pipe Markers.
2. Valve Tags.
3. Equipment Nameplates.
4. Underground Marking Tape.
5. Chart and Diagram Frames.

1.2 REFERENCES

A. ASME A13.1-2015 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Indicate model, type, and application usage.

C. Submit list of wording, symbols, letter size**,** letter style, and color coding for each system and vault cover.

D. Submit valve numbering scheme**,** valve chart and schedule, including valve tag number, location, function type, and valve manufacturer's name and model number.

1.4 COORDINATION

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations and valve and equipment numbering schemes prior to submittal review.

B. Coordinate installation of identifying devices with completion of covering of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment. If not installed before ceiling is installed, the Contractor shall remove ceiling at no additional cost to the OWNER and install identifying devices.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seton Name Plate Corp.

B. Brimar.

C. Brady.

2.2 PIPE MARKERS

A. Markers: ASME A13.1.
1. Pressure sensitive vinyl (self sticking) material.
2. Mechanically fastened type: Snap on or strap on.
   a. For dirty, greasy, or oily pipe where pressure sensitive markers may not perform satisfactorily.
3. All weather film for outdoor exposed piping.
4. Provide 360 degree and pipe flow arrows and fluid being conveyed.
5. Size of letters legend:

OUTSIDE DIAMETER OF PIPE OR PIPE COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS AND ARROWS
3/4 to 1-1/4 inch	8 inch	1/2 inch
1-1/2 to 2 inch	8 inch	3/4 inch
2-1/2 to 6 inch	12 inch	1-1/4 inch
8 to 10 inches	24 inch	2-1/2 inch
Over 10 inches	32 inch	3-1/2 inch

2.3 VALVE TAGS

A. Tags: Brass or anodized aluminum type.
1. Brass: Minimum 19 gauge, polished, 2-inch diameter with following lettering:
   a. Service: 1/4-inch stamped black filled letters.
   b. Valve numbers: 3/8-inch stamped black filled letters.
2. Aluminum: 2 inch diameter, 0.032 inch thick, with following lettering:
   a. Service: 1/4-inch engraved letters.
   b. Valve numbers: 3/8-inch engraved letters.

B. Fasteners: 4 ply 0.018 copper or monel wire meter seals, brass “S” hooks or No. 16 brass jack chain.

2.4 EQUIPMENT NAME PLATES

A. 1/8-inch rigid plastic or bakelite with 4 edges beveled, with black background and white border and letters.
1. Two 3/8-inch mounting holes.
2. Minimum 1/2-inch high lettering.
3. Commercial quality, rust resisting nuts and bolts with backwashers, self tapping screws or rivets.

2.5 UNDERGROUND MARKING TAPE

A. General: Provide underground pipe marking tape on all pipes buried beneath the ground. Provide a continuous length of tape 12 inches below the finished earth surface directly above the buried pipe. Provide a second continuous length of tape 12 inches above the top of the buried pipe if the top of the pipe is lower than 36 inches from the top of the finished earth surface.

B. Tape: 5 mil inert plastic film for underground use.

C. Resistant to alkalis, acids and other destructive agents found in soil; information in Civil Engineers Soils Report.

D. Minimum tensile strength: 120 pounds per 6 inch width.

E. Minimum elongation: 500 percent.

F. Provide detectable underground tape above all buried pipes on the Project. Provide a continuous printed message repeated every 16 to 36 inches warning of pipe buried below similar to (i.e., “CAUTION WATER LINE BURIED BELOW”).

G. Color code:
1. Blue: Water systems, domestic and fire.
2. Green: Sanitary and storm sewer system.

H. Provide tape widths of 2, 3, 6, 9, and 12-inches for lines buried 10, 20, 30, 40, and 50 inches or greater, respectively.

2.6 CHART AND DIAGRAM FRAMES

A. Chart and diagram frames: Extruded aluminum with plexiglass or glass windows.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 VALVE AND EQUIPMENT IDENTIFICATION

A. Designate all equipment and valves by distinguishing numbers and letters on charts and/or diagrams.
1. Tag and locate following equipment items:
   a. Valves.
   b. All items indicated on equipment schedules and plumbing fixtures.
2. Designation shall match that indicated.

B. Install tags on all devices with numbers and letters corresponding to charts.

C. Fasten tags securely to devices with tag fasteners in manner for easy reading.

D. Attach equipment nameplates in conspicuous location, directly on item of equipment or apparatus such as starters and pumps.

E. For unsuitable surfaces, such as high temperature or lack of space, use copper or brass rings or chains to attach tags.

F. Furnish four charts.
1. Mount 1 chart in frame and secure on wall in location directed by OWNER Representative.

2. Include remaining 3 sets in “Operation and Maintenance Manuals”.
3. Show valve tag numbers on project as-built drawings.

G. Provide safety sign for each piece of exposed mechanical equipment that may start automatically. Comply with the requirements of Section 10 14 00.

3.3 PIPE IDENTIFICATION

A. Locate pipe markers as follows:
1. Next to each valve and fitting, except on plumbing fixtures and equipment.
2. At each branch or riser take off.
3. At each passage through walls, floors and ceilings.
4. At each pipe passage to underground.
5. On all horizontal pipe runs every 20 feet, at least once in each room and each story traversed by piping system.
6. Identify piping contents, flow direction, supply and return.

B. Install markers with tape color bands over each end of marker, extending around pipe and overlapping a minimum of 30 degrees.

3.4 SERVICE ABBREVIATIONS

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations as indicated below:

CD	Cooling Coil Condensate Drain Piping (Gravity)
CW	Domestic Cold Water
F	Fire Protection Water Service
HW (x-degrees F)	Domestic Hot Water Supply (indicate temperature)
SS	Sanitary Sewer (in mechanical chases and exposed to view)
SP	Sprinkler System
V	Vent (in mechanical chases and exposed to view)

3.5 INSTALLATION OF UNDERGROUND MARKING TAPE

A. Install underground marking tape directly above all outside utility lines.

B. Allow 12 inches between tape and line, and install as close to grade level as feasible.

END OF SECTION 22 05 53

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Glass fiber (pipe).
2. Cellular foam.
3. Jackets and fitting covers.
4. Inserts and shields.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training, with not less than five years of documented experience.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:
1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
2. Insulation application at pipe expansion joints for each type of insulation.
3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Removable insulation at piping specialties and equipment connections.
5. Application of field-applied jackets.

C. Manufacturer’s Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

E. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29.

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of electric heat tracing.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

PART 2 PRODUCTS

2.1 GLASS FIBER (PIPE)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Knauf Fiber Glass.
2. Owens-Corning Fiber Glass Corp.

B. Insulation: ASTM C547; rigid model; non-compliant; k factor; 0.24-Btu · in/ (h ·ft^2·°F) at 75 degrees; 350 degrees F maximum service temperature; 0.2 percent maximum moisture absorption by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn; bonded to aluminum film with pressure sensitive tape lap sealing system; moisture vapor transmission; ASTM E96; 0.02 perm-inches.

2.2 CELLULAR FOAM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong, Armaflex-AP.
2. Halstead.
3. Approved equal.

B. Insulation: ASTM C534; flexible; cellular elastomeric; molded or shed; k factor; ASTM C177, 0.27 Btu · in/ (h ·ft^2·°F) at 75 degrees; -70 degrees minimum service temperature; 220 degrees F maximum service temperature; maximum moisture absorption: ASTM D1056, 5 percent (pipe) by weight; 6.0 percent (sheet) by volume; moisture vapor transmission: ASTM E96, 0.10 perm-inches

C. Connection: Waterproof vapor barrier contact adhesive compatible with the insulation. Armstrong 520 adhesive or approved equal.

2.3 JACKETS AND FITING COVERS

A. PVC Plastic Jacket and Fitting Covers (Interior Applications):
1. Zeston 2000
2. Approved equal

B. Jackets and fitting covers: ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 degrees F; maximum service temperature 450 degrees F; thickness: 20 mil.

C. Jackets and fitting covers (vapor barrier jackets): ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 degrees F; maximum service temperature 450 degrees F; moisture vapor transmission - ASTM E96 - 0.002 perm-inches; thickness: 20 mil.

D. Connections: Pressure sensitive color matching vinyl tape.

2.4 INSERTS AND SHEILDS

A. Inserts: Heavy density insulation which will not crush from weight of pipe. Locate between shield and pipe. Inserts are furnished in this Section and installed in Section 22 05 29.

B. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insulation. Shields are furnished and installed under Section 22 05 29.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify that piping has been tested and approved before applying insulation material.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Comply with schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Comply with special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
   1. Apply insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced on 4 inches centers.
   3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply 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 on 4 inch centers.

a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gauges, fill and seal voids with vapor-retarder mastic.

P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

Q. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in 07 84 00.

R. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

S. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints.

T. On insulated piping without vapor barrier for pipes conveying fluids 180 degrees or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.

U. All domestic Pipe Exposed in Mechanical Equipment Rooms, Mechanical Chases and Areas with no ceilings and in Finished Spaces less than 10 feet above finished floor: Finish with PVC jacket and fitting covers.

V. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

W. Insulation on all cold water systems shall be applied with a continuous unbroken vapor seal. Do not allow hangers, supports, anchors etc., to come in direct contact with the pipe.

X. Insulate entire system including fittings, unions and flexible connections, flanges and expansion joints.

Y. Insulation shall not be applied until system is tested, cleaned, and approved.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
   3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
   3. Apply insulation to flanges as specified for flange insulation application.
   4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
   5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.
   6. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
   7. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

E. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
   4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

F. Apply insulation to fittings and elbows as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with standard PVC fitting covers.

G. Apply insulation to valves and specialties as follows:
1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2 inch overlap at seams and joints.
2. Embed glass cloth between two 0.062 inch thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets 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-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Apply metal jacket where indicated, 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.

3.7 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section, Painting.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the 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.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.9 FIELD QUALITY CONTROL

A. Inspection: Engage a qualified inspection agency to perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by Architect.
2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.10 INSULATION APPLICATION SCHEDULE, GENERAL

A. Comply with insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:
1. Domestic cold water, except as noted in Schedule at the end of this Section.
2. Domestic hot water.
3. Recirculated hot water.
4. Sanitary drains for fixtures accessible to the disabled.
5. Cooling coil condensate drain piping.

C. Interior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:
1. Domestic hot water.
2. Recirculated hot water.
3. Cooling coil condensate.

D. Mechanical/Plumbing Chases: With regard to pipe insulation, Mechanical/Plumbing chases shall be regarded as interior exposed spaces and domestic cold water not required to be insulated.

3.12 PLUMBING EQUIPMENT APPLICATION SCHEDULE

A. Insulate equipment including valves, tanks, air removal devices, etc.

B. Plumbing equipment shall be insulated under this Section.

C. Expansion tanks and similar equipment not receiving fluid directly from the system do not require insulation.

D. Valves, traps, pressure reducing valves, pumps, etc.: Extend insulation 6 inches beyond flanges.

E. Systems Above Ambient Temperature: 2-inch thick glass fiber insulation with vapor barrier.

F. Systems Below Ambient Temperature: 1/2-inch thick glass fiber insulation with vapor barrier. Exception: Insulate pump bodies on systems below ambient temperature with 1-inch thick cellular foam insulation.

G. All equipment requiring access for maintenance, repair or cleaning shall be insulated with lace-on blankets.

H. All exposed hot water and drain piping at Handicap fixtures shall be insulated with a neatly installed removable type ADA - approved insulation kit equal to Basin Guard, Pro Wrap, or approved equal.

Insulation Schedule					
System	Operating Temperature (degrees F)	Insulation Type	Pipe Size (inches)	Insulation Thickness (inches)	Notes
Domestic hot water and hot water return (above ground)	105 and greater	Glass fiber	Up to 2	1	(1) (2)
			Greater than 2	1-1/2	
Domestic Cold Water (above ground)	___	Glass Fiber	Up to 12	1/2	(2) (4)
Domestic Cold Water (below ground)	___	Cellular foam	Up to 8	1/2	___
Cooling Coil Condensate Drain (Interior only)	___	Cellular foam	Up to 3	1/2	(3)

Notes:

1. Runouts to fixtures which are less than 12 feet in length may have 1/2 inch insulation.
2. Provide PVC jacket and fittings for all piping exposed to view, exposed in water heater rooms, mechanical chases exposed to view in all Dayrooms, mechanical areas, Areas with no ceiling and finished spaces less than 10 feet -0 inches above finished floor.
3. Provide secondary containment pipe.
4. All domestic cold water piping in mechanical and plumbing chases are not required to be insulated.

END OF SECTION 22 07 19

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Settlement Joints.
2. Copper pipe and fittings for above and below ground installation.
3. Pipe wrap for all domestic water piping installed below ground and inside grout-filled block walls.
4. Dielectric unions and fittings.

B. This Contractor shall furnish all labor, materials, pipe supports, sleeves, hangers, tools, equipment and perform all work and services necessary for furnishing and installation of a complete domestic water piping system. Although all work is not specifically shown or specified, all valves, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation shall be furnished and installed as part of this work.

1.2 REFERENCES

A. ASME B31.9 -2017 Building Services Piping, for materials, products, and installation.

B. NSF 61, Drinking Water System Components-Health Effects: Sections 1 through 9, for potable domestic water piping and components.

C. ASME BPVC -2017 SEC IX: Welding and Brazing Qualifications.

D. ASTM E814 -2017: Standard Test Method for Fire Tests of Penetration Firestop Systems.

E. ASTM F708 -2014: Design and Installation of Rigid Pipe Hangers.

F. AWWA C651 -2014: Disinfecting Water Mains.

G. ANSI/UL 1479: Fire Tests of Through-Penetration Firestops.

H. MSS SP-58 -2009: Pipe Hangers and Supports - Materials, Design, and Manufacture.

I. ANSI/MSS SP-69 -2003: Pipe Hangers and Supports - Selection and Application.

J. NCPWB: Procedure Specifications for Pipe Welding.

K. ANSI/AWWA C111 -2017 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings/A21.11

L. ANSI/AWWA C153/A21.53 -2006- Ductile Iron Compact Fittings for Water Service, depending on size of piping for settlement joints.

M. ANSI/AWWA C105/A21.5 -2017 - Polyethylene Encasement for Ductile Iron Pipe Systems, for polyethylene jacket.

1.3 DEFINITIONS

A. Water Service Piping: Water piping outside the building that conveys water to the building.

B. Service Entrance Piping: Water piping approximately 5-feet outside the building, between water service piping and water distribution piping.

C. Water Distribution Piping: Water piping from a point approximately 5-feet outside the building that conveys water to fixtures and equipment throughout the building.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working pressure ratings, unless otherwise indicated:
   1. Domestic Water Distribution Piping, Above Ground: 125 psig.

1.5 SUBMITTALS

A. Submit in accordance with Division 01.

B. Product Data for settlement joints, below and above ground pipe, fittings, couplings, hangers, pipe coating and pipe wrap for pipe installed below ground and installed in grout-filled block walls, seismic bracing and thrust and/or restraint or blocking at base of domestic water riser. Provide manufacturer's catalog information.

C. Shop Drawings
   1. For underground and above ground systems, and all mechanical and plumbing chases. Include plans, elevations, sections, and details.
   2. In accordance with Sections 22 05 29 and 22 05 48.

D. Calculations: In accordance with Sections 22 05 29 and 22 05 48.

E. Water Samples: Specified in Disinfection of Domestic Water Piping System Article in Part 3.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Settle joints shall be FM approved.

1.7 RECORDS

A. Provide record of all pipe tests and provide as part of O & M Manual.

B. Include certificate of Tests in O&M Manual.

C. Include certificate of Health Department approval of domestic water quality in O&M Manual.

D. Provide certificate of Domestic water piping system disinfecting and include in O & M Manual.

1.8 DRAWING SCHEDULE

A. Refer to sheet notes and schedule on Drawings for model numbers, symbols, etc. for additional information concerning products specified in this section.

PART 2 PRODUCTS

2.1 SETTLEMENT JOINT

A. General: Provide settlement joint on all domestic water service entrance pipe to each building, as indicated on the Underground Plumbing Plans.

B. Settlement joint shall be manufactured of 65-45-12 ductile iron conforming to the material requirements of ASTM A536.84 and ANSI/AWWA C153/A21.53. Provide foundry certification of material with submittal.

C. Each settlement joint shall be pressure tested prior to shipment against it own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 12-inch and smaller sizes is required.

D. Each settlement joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of 20 degrees, 3-inch to 12-inch; and 4-inches minimum expansion.

E. All internal surfaces (wetted parts) shall be lined with a minimum of 15-mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500-volt spark test conforming to said specification. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.

F. All external surfaces shall be coated with a catalyzed coal tar epoxy conforming to the material requirements of AWWA C210. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

G. Manufacturer’s certification of compliance to the above standards and requirements shall be provided with submittal.

2.2 PIPING MATERIALS

A. General: The application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems are indicated in Part 3 Article “Pipe Fittings and Applications.”

B. Hard Copper Tube: ASTM B88, Type L, water tube, drawn temper for above ground and in wall installation.

C. Set Copper Tube: ASTM B88, Type K, water tube, annealed temper for below ground installation.
   1. COPPER PIPE AND FITTINGS
      a. Soft Copper Tube: ASTM B88, Types K (ASTM B88M, Types A and B), water tube, annealed temper.

1) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3) Copper Unions: MSS SP-123/ASME B16.18, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
   a) Threaded Ends: Threads conforming to ASME B1.20.1.

b. Hard Copper Tube: ASTM B88, Types L (ASTM B88M, Types B and C), water tube, drawn temper.
1) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3) 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.
   a) Threaded Ends: Threads conforming to ASME B1.20.1.
4) Copper, Grooved-End Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
   a) Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to ANSI/AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

2.3 JOINING MATERIALS

A. Solder, brazing, and welding filler metals are specified in Section 22 05 00, Common Work Results for Plumbing.

2.4 VALVES

A. Comply with Section 22 05 03.

2.5 PIPE WRAP BELOW GROUND AND WITHIN GROUT-FILLED BLOCK WALLS

A. General: Provide pipe wrap for all copper pipe installed below ground and for all horizontal and vertical copper pipe installed inside grout-filled block walls.
1. Cleaning: Remove loose scale, rust, dirt, oil and grease before wrapping. Wire brush as required; use solvent for removal of oil and grease.
2. Provide Calpico Inc. pipe wrapping polyvinyl tape, 20-mil thickness, with identification as per IAPMO-CPC Code for all horizontal and vertical copper piping installed inside grout-filled block walls.
3. Encase in one layer of an ANSI/AWWA C105, 8-mil polyethylene jacket all ground copper pipe installed below ground. Install jacket per ANSI/AWWA C105/A21.5.
4. Encase in two layers of an ANSI/AWWA C105, 8-mil polyethylene jacket, all ductile iron pipe installed below ground. Install jacket per ANSI/AWWA C105/A21.5.

2.6 PIPE INSULATION THROUGH CONCRETE, GRADE BEAMS AND FOOTINGS

A. General: Provide a minimum 1-inch thick pipe insulation for all copper pipe installed through concrete footings, grade beams, etc.
   1. Cleaning: Remove loose scale, rust, dirt, oil and grease before wrapping.
   2. IMOC, IMCOSHIELD, non-slit pre-lubricated polymer foam insulation.

2.7 DIELECTRIC PIPE FITTINGS

A. General: Provide dielectric pipe fittings, unions and waterways to protect domestic water copper pipe from deterioration caused by galvanic and stray current corrosion. Provide dielectric fitting, union or waterway where dissimilar metals are used in piping systems.
   1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
   2. Insulating Material: Suitable for system fluid, pressure, and temperature.
   3. Dielectric Unions: Factory-fabricated, union assembly for 250 psig minimum working pressure at a 180 degrees F temperature.
      a. Manufacturers: Epco Sales, Inc.; Watts Industries, Inc. - Water Products Division or Zurn Industries, Inc. - Wilkins Division.
   4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 or 300 psig minimum pressure to suit system pressures.
      a. Manufacturers: Epco Sales, Inc. or Watts Industries, Inc. - Water Products Division.
   5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
      a. Provide separate companion flanges and steel bolts and nuts for 150 or 300 psig minimum working pressure to suit system pressures.
      b. Manufacturers: Advance Products & Systems, Inc. ; Calipco, Inc. or Pipeline Seal and Insulator, Inc.
   6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 psig minimum working pressure at 225 degrees F temperature.
      a. Manufacturers: Calpico, Inc. or Lochinvar Corp.
   7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 psig working pressure at 225 degrees F temperature. Nipples shall be listed by IAPMO/UPC and SBCCI PST and ESI.
      a. Manufacturers: Precision Plumbing Products, Inc.; Sioux Chief manufacturing Co.,Inc, Perfection Corp. or Victaulic Co. of America.

2.8 PIPE ESCUTCHEONS

A. General: Provide solid (not split-hinged) pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. All areas with escutcheons shall be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid cast brass or sheet brass escutcheons, solid pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturer: Chicago Specialty, Producers Specialty, Sanitary-Dash.

2.9 FIRE BARRIER PENETRATION SEALS

A. Provide seals for opening through fire-rated walls, floors, or ceiling used as passage for mechanical components such as piping or ductwork. Refer to details on Drawings.
   1. Piping: Provide fire stopping material as specified in Section 07 84 13.

PART 3 EXECUTION

3.1 PIPING AND FITTINGS APPLICATIONS

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 may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Underground Domestic Water Service Entrance Piping: Use the following piping materials:
   1. 6 inches and Smaller: Soft copper tube, Type K, cast-copper-alloy, soldered-joint pressure fittings; and soldered joints with Alloy Sn95 solder.
   2. All copper pipe installed below finished grade and slab shall be encased in one layer of an ANSI/AWWA C105, 8-mil polyethylene jacket installed per ANSI/AWWA C105/A21.5.

E. Aboveground Domestic Water Distribution Piping: Use the following piping materials:
   1. 6 inches and Smaller: Hard copper tube, Type L wrought-copper or cast-copper-alloy pressure fittings; copper unions; bronze flanges and soldered joints with Alloy Sn95 solder.
   2. Provide transition fitting (C900 PVC-to-Copper) at location indicated outside the building. Coordinate with Civil Drawings.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use full port ball or butterfly valves.
   2. Hot Water, Balancing Duty: Calibrated balancing valves, comply with the requirements :
      a. Multi-function valve that incorporate an isolation ball valve, a 20-mesh strainer and flow control cartridge in the same body. Valve shall not be replaced by functionally equivalent separate components that increase the material and labor cost of the project. Five (5) year warranty on the valves.
      b. Griswold “Isolator Y”, no other equal known. (Circuit setters not allowed)
      c. Provide hot water return balancing valves in domestic hot water recirculating systems where indicated on the Plumbing Drawings and Piping Diagram.
   3. Drain Duty: Hose-end drain valves.
   4. Isolation Duty: Use full port ball valves.

B. All iron body valves installed below finished grade shall be encased in two layers on an ANSI/AWWA C105, 8-mil polyethylene jacket installed per ANSI/AWWA C105/A21.5.

3.3 PIPING INSTALLATION

A. Contamination Prevention:
   1. Pipe interiors shall be kept free of debris.
   2. Interior surfaces of domestic water pipes, valves and fittings shall be protected against contamination, as well as debris. All openings in pipelines shall be closed with watertight plugs when worked is halted on the system. Sealing and packing materials shall not support growth of bacteria. Trenches that become wet shall be treated with calcium hypochlorite granules to prevent bacterial growth.

B. General:
   1. The installation of the domestic water systems shall conform to the latest edition of California Plumbing Code (CPC) and this specification.
   2. Piping installation shall be coordinated with respect to space available for HVAC, fire protection and electrical installation. In case of conflict in the routing of the piping and ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows; shall not encroach on aisles, passageways and equipment and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Pipe shall not be bent. Cutting or weakening of structural members to facilitate piping installation is not permitted.
   3. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall run parallel with the lines of the building unless otherwise noted on the drawings. Service pipe, valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1-inch from such other work and not less than 1-inch between finished covering on the different services.

C. Comply with the requirements of Section 22 05 00.

D. Extend domestic water distribution piping to a point 5 feet outside each building and in sizes and locations indicated. Connect to water service entrance piping, coordinate point of connection with Civil Drawings. Provide transition fitting, C900 PVC-to-copper.

E. Install underground copper tubing according to CDA's "Copper Tube Handbook."

F. Install wall penetration system at service pipe penetration through foundation wall. Make installation watertight. Comply with Section 22 05 00.

G. Install aboveground domestic water piping level without pitch and plumb.

H. Provide and install electric heat trace temperature maintenance on all non-recirculating domestic hot water systems to maintain temperatures indicated on Drawings. Heat trace shall extend from water heater, mechanical room to within 15 feet minimum of each fixture. Install per manufacturer's instructions.

3.4 JOINT CONSTRUCTION

A. Comply with Section 22 05 00 for basic piping joint construction.

B. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated.

C. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. Option for fittings: Copper press connections. Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

3.5 VALVE INSTALLATION

A. General: Valves shall be installed at the locations shown on the drawings, as required by code and for isolation of equipment, plumbing fixtures, etc. All valves shall be installed with the stems between the horizontal the 90 degrees vertical. Provide access to all concealed valves by means of access doors furnished and installed by the Contractor.

B. Sectional Valve: Install sectional valves close to water main on each branch and riser serving 2 or more plumbing fixtures or equipment connections and where indicated. Use ball valves for piping 4 inches and smaller. Use butterfly valves for piping 5 inches and larger.

C. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping 4-inches and smaller. Use butterfly valves for piping 5 inches and larger.

D. Drain Valves: Install drain valves specified in Section 22 11 19 on each plumbing equipment item located to drain equipment for service and repair. Install drain valves at base of each water riser, at low points in horizontal piping, and where required to drain water distribution piping system.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

E. Mechanical and Plumbing Chases: Install ball valve on each branch serving each plumbing chase.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with the requirements of Section 22 05 48 and Section 22 05 29 for seismic-restraint devices and pipe hanger and supports.

B. Install hangers for horizontal and vertical piping with the following maximum spacing and minimum rod sizes:
   1. Support vertical copper tube at each floor.
   2. Install supports for vertical copper tubing every 10 feet.

C. Conform to Table below for maximum spacing of supports:

Pipe Material	Horizontal In Feet	Vertical In Feet	Rod Size In Inches
Copper Tubing 1-1/4 inches and smaller:	6	10	3/8 inch
Copper Tubing 1-1/2 inches and larger:	10	10	1/2 inch

D. Support horizontal and vertical piping inside each mechanical chase using cold formed metal framing ("Superstrut"), comply with requirements of Section 22 05 48 and Section 22 05 29.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water distribution piping to exterior water service entrance piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to the following:
1. Water Heaters: Install cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Install cold and hot water supply piping in sizes indicated, but not smaller than required by the latest edition of California Plumbing Code (CPC) and/or authorities having jurisdiction. Refer to Section 22 40 00 and Section 22 11 19.
3. Equipment: Connect cold and hot water supply piping to equipment as indicated, but not smaller than equipment connections and as required by CPC. Provide ball valve and union for each connection; provide drain valve on drain connection. Use flanges instead of unions for 5-inches and larger.

3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
1. Do not enclose, cover, or put piping into operation until all piping is inspected and approved by local plumbing official and/or authority having jurisdiction.
2. During progress of the installation, notify local plumbing official and/or authority having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the local plumbing official and/or authority having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping system before concealing or closing-in after roughing-in and prior to setting fixtures.
   b. Final Inspection: Arrange for final inspection by local plumbing official and/or authority having jurisdiction to observe tests and to ensure all systems are in compliance with requirements of the latest edition of California Plumbing Code.
3. Reinspection: When a plumbing official finds that a piping system will not pass test or inspection, Contractor shall make the required corrections and arrange for reinspection by the plumbing official.

4. Reports: Prepare inspection reports and have them signed by the local plumbing official and/or authority having jurisdiction. A copy of all inspection reports to be included in the O & M Manuals.
5. Provide written report to Architect and Engineer that all copper piping installed below ground and inside grout filled block walls have been coated and wrapped with approved pipe wrap. Written report shall be included in the O & M Manuals.

B. Test domestic water distribution piping as follows:
1. Test for leaks and defects in new water distribution piping system and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water distribution piping until it has been tested and approved. Expose work that was covered or concealed before it has been tested and approved for testing.
3. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 ADJUSTING

A. Adjust balancing valves in hot-water system to provide adequate flow.
1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
2. Adjust calibrated balancing valves to flows indicated on the Plumbing Drawings or Domestic Water Piping Diagram.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete and clean.

B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Disinfect potable domestic water distribution piping as follows:
1. Purge new domestic water distribution piping systems before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed by that authority, the procedures described in either AWWA C651 or AWWA C652 or as 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 (50 mg/L) 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 (200 mg/L) 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. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 of outlets.
e. If final disinfectant residual test less than 25 mg/L, repeat treatment.
f. Flush disinfectant from system until residual equal to that of incoming water or 1.0mg/L.
g. Take samples no sooner than twenty-four (24) hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651. Provide laboratory results to OWNER Representative. Obtain approval from local health department.

D. Prepare and submit reports of purging and disinfecting activities.

E. Completely flush all domestic hot and cold water risers to eliminate all debris in the lines before using any flush valves.

F. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 STARTUP SERVICES

A. Verify incoming water pressure and temperature.

B. Replace all strainer screens with new at all mechanical and plumbing equipment.

C. Fill water systems. Check potable water expansion tanks to determine that they are not air bound and that system is completely full of water.

D. Before operating systems, perform these steps.
1. Close drain valves, hydrants, and hose bibbs.
2. Open all valves to full open position.
3. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.
4. Remove and clean strainer screens and aerators. Close drain valves and replace drain plugs.

E. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

F. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 PROTECTION

A. Protect piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or when work stops.

END OF SECTION 22 11 16

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SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. No-Hub Pipe, fittings (above ground).
2. No-Hub Heavy Duty Couplings (above ground).
3. Settlement Joints.
4. Pipe Wrap for all sanitary waste and vent piping installed below ground and inside grout-filled block walls.
5. Settlement Joints.
6. Pipe Escutcheons.

B. This Contractor shall furnish all labor, materials, sleeves, hangers, supports, tools, equipment and perform all work and services necessary for furnishing and installation of a complete sanitary waste and vent piping system. Although all work is not specifically shown or specified, all appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation shall be furnished and installed as part of this work.

C. This Contractor shall furnish to OWNER Representative a digital record of all underground sanitary waste and vent and grease waste and vent piping prior to issuing Certificate of Occupancy. Contractor shall review with the OWNER Representative entire underground waste and vent system for each building. All blockages and debris found shall be removed and piping systems replaced at no cost to the OWNER.

1.2 DEFINITIONS

A. Sanitary Waste and Vent Piping: Piping inside the building that conveys waste water and vapors from fixtures and equipment throughout the building.

B. Service Entrance Piping: Sanitary sewerage piping to a point approximately 5 feet outside each building between outside building sewer piping and inside sewer piping.

C. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewerage from building.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Indirect Waste and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Submit in accordance with Division 01.

B. Product Data for settlement joints, hub and spigot pipe and fittings, No-hub pipe, fittings, and heavy duty couplings, hangers, supports, pipe wrap for pipe installed below ground and

installed in grout filled block walls, thrust and/or restraints or blocking at base of each sanitary stack, and seismic bracing. Provide manufacturers catalog information.

C. Shop Drawings
   1. For underground and above ground systems, and all mechanical and plumbing chases. Include plans, elevations, sections, and details.
   2. Details for the installation of the sanitary waste and vent piping for to be supported from the structural slab.
   3. In accordance with Sections 22 05 29 and 22 05 48.

D. Calculations: In accordance with Sections 22 05 29 and 22 05 48.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of CISPI, IAMPO and the specified testing agency.

B. Comply with the provisions of ASME B31.9 “Building Services Piping,” for materials, products, and installation.

C. All cast iron pipe and fittings shall be manufactured in the United States. Pipe shall bear the label or stamp that the cast iron was manufactured in the United States, with collective trademark of the Cast Iron Soil Pipe Institute.

D. Submittal for No-Hub heavy duty couplings to include copy of compliance to the requirements of FM 1680 Class I.

1.6 TESTING

A. Sanitary and Vent Piping:
   1. Test all building sanitary and grease sewer and venting to ensure system is water tight.
   2. All sanitary drainage piping shall be tested to the point of connection to mains outside each building.
   3. Refer to Part 3, Article “Testing” of this section.

B. Records:
   1. Provide record of all pipe tests and include in O&M Manual.
   2. Include certificate of all Tests in O & M Manual.
   3. Include digital record of all underground sanitary waste; grease waste and vent piping systems in O&M Manual.

1.7 DRAWING SCHEDULE

A. Refer to schedules on drawings for model numbers, symbols, and additional information concerning products specified in this section.

PART 2 PRODUCTS

2.1 PIPING MATERIALS MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed from that category:
   1. Hub and Spigot Cast Iron Pipe and Fittings:
      a. AB&I, Oakland, California.
      b. Tyler Pipe Industries, Tyler, Texas.
   2. No-Hub Cast Iron Pipe and Fittings:
      a. AB&I, Oakland, California.
      b. Tyler Pipe Industries, Tyler, Texas.
   3. No-Hub Heavyweight Couplings:
      a. Anaco, Inc., Oakland, California; Husky SD4000-Orange Shield.
      b. No other couplings are acceptable.

2.2 HUB AND SPIGOT SOIL, WASTE AND VENT PIPING

A. Hub and Spigot Pipe and Fittings:
   1. Service Cast Iron pipe and fittings shall be manufactured from gray cast iron with a tensile strength of not less than 21,000 psi.
   2. Pipe and fittings shall comply with ASTM A74. Compression gaskets shall be hydrostatically (water) tested by the manufacturer to verify compliance.
   3. Joints shall be made with an elastomeric compression gasket meeting requirements of ASTM C564.

2.3 CAST-IRON NO-HUB SOIL, WASTE AND VENT PIPING AND FITTINGS

A. No-Hub Pipe: Hubless cast iron pipe and fittings shall be manufactured from gray cast iron with a tensile strength of not less than 21,000 psi. Pipe and fittings shall comply with ASTM A888 and CISPI 301. Each length of pipe shall be hydrostatically (water) tested by the manufacturer to verify compliance. All systems shall utilize a separate waste and vent system.

B. Joints for Hubless Cast Iron Pipe and Fittings Above Grade: Couplings for joining hubless cast iron soil pipe and fittings conforming to ASTM A888, shall be 3 inches wide for nominal pipe sizes 1-1/2 to 4 inches in diameter, 4 inches wide for nominal pipe sizes 5 to 10 inches in diameter. Shields shall have a minimum thickness of 0.015 inches (28 gauge) type 304 stainless steel. Worm drive clamps shall be type 304 stainless steel with a minimum clamp torque of 80 in/lbs. Sealing Gasket shall be neoprene conforming to ASTM C564. Couplings shall conform to FM 1680, Class 1 or ASTM C1540.
   1. Alternate to above, cast iron split clamps secured by stainless steel bolts and nuts with neoprene gasket conforming to ASTM C564, as manufactured by MG Coupling Company.
   2. FM approved couplings may be hung with one hanger per length of pipe for 10-foot lengths and at every third fitting where they are contiguous in conformance with manufacturers installation instructions.

2.4 PIPE ESCUTCHEONS

A. General: Provide solid (not split-hinged) pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. All areas with escutcheons shall be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid cast brass or sheet brass escutcheons, solid pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturer: Chicago Specialty, Producers Specialty, Sanitary-Dash.

2.5 FIRE BARRIER PENETRATION SEALS

A. Provide seals for opening through fire-rated walls, floors, or ceiling used as passage for mechanical components such as piping or ductwork. Refer to details on Drawings.
1. Piping: Provide fire stopping material as specified in Section 07 84 13.

PART 3 EXECUTION

3.1 EXCAVATION

A. Comply with Division 2 Sections for sitework, excavating, trenching, and backfilling.

3.2 SERVICE ENTRANCE PIPING

A. Extend building sanitary and grease waste piping and connect to building sanitary and grease drainage piping of size and in location indicated on the underground plumbing drawings for service entrance to each building in. Coordinate invert elevations, pipe sizes and points of connection with the Civil Drawings. Install cleanout and extension to grade at connection of building sanitary drainage.

B. Provide settlement joint at each service entrance to each building as indicated on the Plumbing Drawings.

3.3 PIPE SUPPORT FOR BUILDING WITH SUPPORTED SLABS

A. Attach all sanitary and grease waste drainage piping to structural slab as indicated on the underground plumbing plans for each building.

B. Comply with the requirements of Article 1.5 D of this Section.

3.4 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Underground, Sanitary Drainage Piping: Use the following:
1. 2 to 8 inches: Use service weight hub and spigot cast-iron pipe and fittings.
2. Encase all underground piping in two (2) layers of ANSI/AWWA C105, 8-mil polyethylene jacket installed per ANSI/AWWA C105/A21.5 Standards.

C. Aboveground, Sanitary Waste Drainage Piping: Use the following:
1. 2 to 8 inches: Use hubless cast-iron pipe; hubless cast-iron pipe fittings; and hubless cast-iron heavy duty stainless steel couplings.

3.5 SANITARY WASTE AND VENT PIPING INSTALLATION

A. General: 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."

B. Make changes in direction for sanitary waste drainage 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.

C. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in piping and pull past each joint as completed.

D. Install sanitary drainage piping at the following minimum slopes, except where another slope is indicated on the plumbing drawings:
   1. Building Sanitary Waste Drain: 1/4 inch per foot (2 percent) downward in direction of flow for piping 6 inches and smaller; unless otherwise indicated on the Drawings.
   2. Horizontal Storm Drainage Piping: 1/4 inch per foot (2 percent) downward in direction of flow, unless otherwise indicated on the Drawings.

E. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by local plumbing inspector or authorities having jurisdiction.

G. Maximum deflection (change in the direction of the line) shall not exceed ½-inch per foot of pipe.

H. Maintain proper alignment during backfilling, stabile the pipe in proper position by partial backfilling and cradling.

I. Piping laid on grade shall be adequately secured to prevent misalignment when slab is poured.

J. Closet bends installed under slabs shall be adequately secured.

K. Aboveground Horizontal Piping, Suspended: 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."

L. Support horizontal pipe and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe at every coupling, located not more than 18-inches for the joint.

M. Support terminal ends of all horizontal runs or branches at each change of direction or alignment with approved hanger.

N. Closet bends installed above ground shall be firmly secured.

O. Horizontal pipe and fittings 6 inches and larger shall be braced to prevent horizontal movement. Provide at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method to prevent movement or joint separation.

P. Vertical Piping: 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."

Q. Support vertical piping at sufficiently close intervals to maintain alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at each floor level. Provide riser clamps not to exceed 15'-0".

R. If vertical piping is to stand free of any support or if no structure element is available for stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.

S. Closet bends installed above ground shall be firmly secured.

3.6 JOINT CONSTRUCTION

A. 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. Hubless Joints: Make with heavyweight rubber gasket.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with Section 22 05 29 for pipe hanger and support devices and Section 22 05 48 for seismic-restraint devices.

B. Conform to Table below for maximum spacing of supports:

Pipe Material	Horizontal In Feet	Vertical In Feet
Cast Iron Soil Pipe	5	15

C. Pipe Attachments: Install the following:
   1. Riser Clamps: MSS Type 8 or Type 42 for vertical runs.
   2. Adjustable Steel Clevis Hangers: MSS Type 1 for individual straight runs to 100 feet and less.

D. Support cast-iron soil pipe and fittings not included in Table, at a maximum horizontal spacing of 5 feet, except 10-foot sections of pipe may be supported at 10-foot spacing and at a maximum vertical spacing of 15 feet.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect sanitary waste drain piping to exterior sanitary drainage piping. Use transition fitting to join dissimilar piping materials. Coordinate with Civil Drawings.

C. Connect sanitary waste drainage piping to the following:
   1. Plumbing Fixtures and Equipment: Connect drainage piping in sizes indicated on Plumbing Drawings.

3.9 FIELD QUALITY CONTROL

A. During installation, notify local plumbing official or authority 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 local plumbing official and/or authority having jurisdiction to observe tests and to ensure all systems are in compliance with requirements.

B. Reinspection: If local plumbing official and/or authority 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 local plumbing official and/or authority having jurisdiction. A copy of all inspection reports shall be included in the O&M Manuals.

3.10 TESTING

A. Test sanitary and grease drainage and vent piping according to procedures of local plumbing inspector and as follows:
   1. 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 separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in piping installation. Tightly close all openings in the piping system, torque all couplings to recommended 80 in/lbs and all bends, changes of direction and ends of runs should be properly restrained prior to testing. Contractor shall have the option of hydrostatic or air test the system(s) as followings:
      a. Hydrostatic or Water Test: Prior to the hydrostatic test expelled all air from the system. A hydrostatic test of 10 feet of hydrostatic pressure (4.3 pounds per square inch) shall be performed. Test system for a minimum of 15 minutes, water level must not drop. Inspect joints for leaks.
      b. Air Test: The system shall be pressurized to a maximum of 6 psi utilizing a gauge graduated to no more than 3 times the test pressure. The gauge shall be monitored during the 15 minute test. A reduction of more than 1 psi during the test period indicates failure of the test.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into

piping system equal to pressure of 1-inch water column. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.11 CLEANING

A. Clean interior and exterior of piping prior to installation. 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.

3.12 STARTUP SERVICES

A. Before operating systems, perform these steps:
1. Remove all plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.

B. Check plumbing equipment and verify proper settings, adjustments, and operation.

C. Check plumbing specialties and verify proper settings, adjustments, and operation.

D. Refer to Part I, article 1.2/F.

3.13 PROTECTION

A. Protect all piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or when work stops.

END OF SECTION 22 13 16

SECTION 22 34 00 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Gas-fired, tankless, domestic-water heaters.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters 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**.**

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

B. LEED Submittals:

   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

   1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of gas-fired, tankless, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 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 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Gas-Fired, Tankless, Domestic-Water Heaters:

1) Heat Exchanger: Five years.
2) Controls and Other Components: Three years.

PART 2 - PRODUCTS

2.1 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS

A. Approved manufacturers:
1. Navien
2. Approved equal

B. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for indoor application.

C. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.

1. Tappings: ASME B1.20.1 pipe thread.
2. Pressure Rating: 150 psig.
3. Heat Exchanger: Copper tubing.
4. Insulation: Comply with ASHRAE/IESNA 90.1.
5. Jacket: Metal, with enameled finish, or plastic.
6. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.
7. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
8. Temperature Control: Adjustable thermostat.

D. Support: Bracket for wall mounting.

E. Capacity and Characteristics:

1. Flow Rate: 4.3 gpm at 67 deg F temperature rise.
2. Temperature Setting: 120 deg F.
3. Fuel Gas Demand: 259 cfh.

4. Fuel Gas Input: 150,000 Btu/h.

5. Electrical Characteristics:

   a. Volts: 120.
   b. Phase: Single.
   c. Hertz: 60.

6. Minimum Vent Diameter: 2 inches.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Tankless, Domestic-Water Heater Mounting: Install tankless, domestic-water heaters on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Fill domestic-water heaters with water.

C. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Comply with requirements for fuel-oil piping specified in Section 23 11 13 "Facility Fuel-Oil Piping."

C. Comply with requirements for gas piping specified in Section 23 11 23 "Facility Natural-Gas Piping."

D. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 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.
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 operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, tankless domestic-water heaters.

END OF SECTION 22 34 00

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SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Water Closets (Commercial).
2. Lavatories (Commercial).
3. Showers (Commercial).

B. Products Installed but not Furnished Under This Section:
1. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Supply of integral lavatory counter tops for placement by this Section.

1.2 REFERENCES

A. ADAAG - Americans with Disabilities Act Accessibility Guidelines.

B. ANSI/ASME A112.6.1M-2017 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

C. ANSI/ASME A112.18.1-2017 - Plumbing Fixture Fittings.

D. ANSI/ASME A112.19.2M-2017 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.3-2017 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

F. ANSI/ASME A112.19.4M-1994 (R1999) - Porcelain Enameled Formed Steel Plumbing Fixtures.

G. ASME A112.19.5-2017 - Trim for Water-Closet Bowls, Tanks, and Urinals.

H. ICC A117.1, - Accessible and Usable Buildings and Facilities.

I. CRR Title 24, Part 2, Section 511 and Part 5, Chapter 15.

J. Energy Policy Act of 1992 (EPACT)

K. IAPMD/UPC

1.3 DEFINITIONS

A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.

B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.

C. Appliance: Device or machine designed and intended to perform a specific function.

D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.

E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.

F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

G. Fixture: Installed receptor connected to the water distribution system that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.

H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.

I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
   1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
   2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
   3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
   4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.

J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1.

B. Product Data: For each type of plumbing fixture specified, provide catalogue illustrations, sizes, rough-in dimensions, utility sizes including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

C. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring, as required.

D. Maintenance Data: Include fixture trim exploded view and replacement paints list. Plumbing fixtures to include in maintenance manuals specified in Division 1.

E. Warranty: Submit manufacturer's standard warranty and ensure forms have been completed in OWNER's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixture having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixture is on the proposer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. 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"; about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.

E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.6 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

1.7 DELIVERY, STORAGE, HANDLING. AND PROTECTION

A. Deliver plumbing fixtures in manufacturer's protective packing, crafting, and covering. Inspect for damage. Report damage to OWNER field responsible.

B. Store and protect plumbing fixtures from damage on elevated platforms in a dry location by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Furnish quantity of identical units not less than 10 percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Furnish quantity of identical units not less than 5 percent of amount of each type and size installed.

3. Faucet, Laminar-Flow Fittings: Furnish quantity of identical units not less than 10 percent of amount of each type and size installed.
4. Faucet, Flow-Control Fittings: Furnish quantity of identical units not less than 10 percent of amount of each type and size installed.
5. Flushometer Repair kits: Furnish quantity of identical units not less than 10 percent of amount of each type and size installed.
6. Toilet Seats: Furnish quantity of identical units not less than 10 percent of amount of each type toilet seat installed.

PART 2 PRODUCTS

2.1 WATER CLOSET – FLOOR MOUNTED FLUSH TANK WC-1

A. Manufacturers:
1. American Standard, Inc.

B. Description:
1. Material: Vitreous China.
2. Color: White
3. Bowl Configuration: Elongated tank type.
4. Mounting and Outlet: Floor mounted, bottom outlet.
5. Rim Height: 17inches above finished floor. Coordinate mounting heights with Architectural Plans and Elevations.
6. Water Consumption: As required by Code.
7. Wall Construction: As indicated on Architectural Drawings.
8. Fittings and Accessories :Provide the following compatible components:
   a. Flushtank: Exposed, lifting handle up as required by Code. Where used for ADA accessible, water closets, the flush valve handle shall be mounted on the wide side of the WC enclosure.
   b. Toilet Seat: Solid Plastic open front

2.2 WATER CLOSET (STAFF) (ADA COMPLIANT) WC-2

A. Manufacturers:
1. American Standard, Inc.

B. Description:
1. Material: Vitreous China.
2. Color: White
3. Bowl Configuration: Elongated tank type.
4. Mounting and Outlet: Floor mounted, bottom outlet.
5. Rim Height: 17inches above finished floor. Coordinate mounting heights with Architectural Plans and Elevations.
6. Water Consumption: As required by Code.
7. Wall Construction: As indicated on Architectural Drawings.
8. Fittings and Accessories :Provide the following compatible components:
   a. Flushtank: Exposed, lifting handle up as required by Code. Where used for ADA accessible, water closets, the flush valve handle shall be mounted on the wide side of the WC enclosure.
   b. Toilet Seat: Solid Plastic open front

2.3 LAVATORY WALL HUNG (ADA COMPLIANT) L-1

A. Manufacturers:
1. American Standard, Inc.
2. Crane Plumbing/Fiat Products.

B. Description:
1. Material: Vitreous China
2. Color: White
3. Lavatory Size: 20 inches x 18 inches.
4. Mounting and Outlet:Wall mounted, wall outlet.
5. Rim Height: ADA Compliant. (Coordinate mounting height with Architectural Plans and Elevations.)
6. Wall Construction: Type of wall indicated on Architectural Floor Plans.
7. Faucet, Fittings and Accessories: Provide the following compatible components:
   a. Faucet: Kohler Coralais Model K-15199-P-CP, single control lavatory faucet.
   b. Supplies: Lavatory Type 1.
   c. Drain: Kohler K-7715 Grid Drain.
   d. Trap: Lavatory Type 1.
   e. Support Type: J.R. Smith, lavatory supports with concealed arms; floor mounted with “Pro-Set” uprights, Model 0700.

2.4 SHOWER SH-1

A. Manufacturers:
1. Delta.
2. Approved equal.

B. Shower trim:
1. Solid brass forged body.
2. Temperature only controlled with handle.
3. Field adjustable to limit handle rotation into hot water zone.
4. 120° maximum handle rotation.
5. All parts replaceable from the front of the valve.
6. 1.75 gpm max @ 80 psi, 1.5 gpm @ 80 psi for product marked -H2O
7. Floor and shower drain, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots and "TYPE B" polished nickel bronze, light-duty strainer.

2.5 SHOWER (ADA COMPLIANT) SH-2

A. Manufacturers:
1. Delta.
2. Approved equal.

B. Shower trim:
1. Polished chrome plated finish – Pressure Balance cartridge – Temperature only controlled with handle – field adjustable to limit handle rotation into hot water zone.
2. Integral checks in the cartridge prevent crossflow between Hot and Cold water inlets.
3. Cartridge rated minimum 1.2 gpm @ 45psi
4. Non-Removable blue/red visual indicator for cold, mixing and hot handle positions.

5. Standard 24" stainless steel bar with ADA slide handshower and shower diverter valve-backflow protection provided by two integral check valves in handshower.
6. ADA compliant diverter handle
7. Handshower MAX: 1.5 GPM @ 80psi
8. Handshower MIN: 1.13 GPM @ 45psi
9. Handle #: 3 – lever blade handle – ADA compliant – 2.24"
10. #3 shower – showerhead, arm & flange
11. #3 shower flow rate MAX: 1.5GPM @ 80psi
12. #3 shower flow rate MIN: 1.13 GPM @ 45psi
13. Zurn ZS880 linear trench drain

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for potable cold water and hot water supplies and soil and for waste and vent piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
   1. Chair carriers for the following fixtures:
      a. Wall-hanging lavatories and sinks.
   2. Heavy-duty chair carriers for the following fixtures:
      a. Accessible lavatories.
      b. Fixtures where specified.
   3. Reinforcement for the following fixtures:
      a. Wall-mounted lavatories required to be secured to wall.
      b. Wall-mounted sinks required to be secured to wall.

3.3 INSTALLATION OF PLUMBING FIXTURES

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
   1. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-hanging 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-hanging fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

H. 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.
   1. Exception: Use ball valve if stops are not specified with fixture. Comply with Section 22 05 23, "General-Duty Valves for Plumbing Piping" for general-duty valves.

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

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 escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with Section 22 05 00, for escutcheons.

S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. The drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Connect water supplies from water distribution piping to fixtures.
   2. Connect drain piping from fixtures to drainage piping.
   3. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
   4. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
   5. Ground equipment.
      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 and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed 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.

3.6 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.7 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Clean to new condition. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.8 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Piping materials and installation common to most piping systems.
2. Dielectric unions and flanges.
3. Escutcheons.
4. Mechanical sleeve seals.
5. Sleeves.
6. Motors and drives.
7. Combination magnetic starters.
8. Equipment guards.
9. Equipment installation requirements common to equipment Sections.
10. Adjusting and cleaning.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME).
1. ASME B31.1-2016 - Power Piping.
2. ASME B31.9-2014 - Building Services Piping.
3. ASME B16.20-2012 - Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.
4. ASME B16.10-2017 (R2003) - Face to Face and End to End Dimensions of Valves.
5. ASME B16.34-2013 - Valves Flanged, Threaded and Welding End.

B. National Certified Pipe Welding Bureau (NCPWB).

C. Standard Procedure Specifications

D. ANSI Standards.
1. ANSI B16.20 - 2012 - Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.

E. AWWA Standards
1. AWWA C111/A21.11-07: Rubber-Gasket Joints for Ductile–Iron Pressure Pipe and Fittings

F. MSS Compliance:
1. MSS SP-25-2013 - Marking System for Valves, Fittings, Flanges and Unions.
2. MSS SP-72-2010 - Ball Valves with Flanged or Butt-Welding Ends for General Service.
3. MSS SP-80-2013 - Bronze Gate, Globe, Angle and Check Valves.

G. FCI Compliance:
1. FCI 73-1-2003 - Pressure Rating Standard for “Y” Type Strainers.
2. FCI 78-1-2003 - Pressure Rating Standard for Pipeline Strainers other than “Y Type.

1.3 DEFINITIONS

A. "Piping" includes, in addition to pipe, all fittings, flanges, valves, hangers and other accessories related to such piping.

B. "Wiring" includes in addition to conductors, all raceway, conduit, fittings, boxes, switches, hangers and other accessories related to such wiring.

C. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings or embedded in construction.

D. "Exposed" means not installed underground or "concealed" as defined above.

E. "Provide" means to furnish and install.

1.4 SUBMITTALS

A. General
1. Comply with the requirements of Division 1 and the specific requirements of the Sections of Division 23.
2. Submit all similar equipment together as part of the same submittal. For example:
   a. All exhaust fans shall be contained in the same submittal.
   b. All fan coil units shall be contained in the same submittal.
   c. All air outlets shall be contained in the same submittal.
3. Contractor shall review all submittals prepared by each supplier and mark all copies as acceptable to the Contractor. This acceptance shall signify that all required service connections are shown and in the proper location to meet the installation requirements and that the equipment can fit in the space allowed.
4. Do not order equipment until submittals have been reviewed and approved by the OWNER Representative.
5. Each item submitted shall be labeled or identified the same as on the Drawings.
6. Mark submittal "Exactly as Specified" or accompanied by a letter from the supplier explaining in detail what difference, if any, exists between the submitted item and the specified item. Failure to point out the differences will be considered cause for disapproval. The OWNER Representative will not assume any responsibility for differences concealed or otherwise not brought to their attention, and the Contractor will be required to correct any deficiencies or differences discovered at a later date, and assume responsibility for any delays, damage, and/or expenses incurred by others due to such action.
7. Brands or trade names are mentioned to set standards of quality only; use no substitute materials, however, unless approved in writing by the OWNER Representative. Approval of substitute materials does not relieve the Contractor of responsibility for providing a workable and functioning system as specified.
8. Submittals will be checked for general conformance with the design concept but acceptance by the OWNER Representative in no manner is meant to verify that dimensions, quantities, or location of services are as necessary to meet the job requirements. This remains the responsibility of the Contractor.

B. Shop Drawings
1. General: Prepare and submit plans, sections, details and diagrams to required scales for specified areas. Drawings shall be coordinated, dimensioned and indicate equipment, piping, and ductwork in relation to architectural and structural features as well as other

building systems. Include Minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers etc.

2. Required Drawings: Prepare and submit drawings for all areas and all mechanical work. Scale shall be minimum 3/8" = 1'-0" in mechanical rooms, fan rooms, and mechanical areas, and minimum 1/4" = 1'-0" elsewhere.

C. Coordination Drawings
   1. General: Coordination drawings are defined as "shop drawings" which also indicate, on the same drawings, the major utilities of all other trades. "Coordination Drawings" shall indicate location and elevations of structural slabs and beams, architectural elements, domestic water piping, plumbing vents, sanitary drains, storm drains, fire protection piping, lighting fixtures, electrical conduits (2-inch and larger), ductwork, penetrations of walls and roof, fire dampers, fire/smoke dampers, automatic dampers, terminal boxes, air outlets, access panels, ceiling mounted equipment and controls, gas piping, flues, fans, air handling equipment, etc.
   2. Submit coordination drawings for the following:
      a. Entire building.
      b. Other areas for which space is limited.
   3. It is the intent of the coordination drawings to ensure coordination of all major utilities, prior to the start of installation. This is a substantial effort which will require careful and detailed coordination and planning to ensure appropriate information is available, from all trades, in a timely manner. The coordination drawing effort shall be integrated into the project schedule and monitored to ensure conformance.
   4. Conflicts between trades, which cannot be resolved through generally accepted practice of coordination between trades, shall be clouded on the coordination drawings and an appropriate description of the problem noted for review by the OWNER Representative.
   5. Nonconforming M/E work installed within designated coordination areas is subject to removal and replacement by installing contractor at no additional cost to OWNER.
   6. Coordination drawings shall be signed and dated by individual trade constrictors. By act of signature and submittal of singular combined coordination drawings, each trade contractor acknowledges coordination of their portion of the Work with all other plumbing, mechanical, electrical, architectural, and structural work contractors.

D. Product Data
   1. General: Manufacturer's specifications, data sheets, certified drawings, and installation instructions. Include physical and performance data such as weights, sizes, capacities, required clearances, performance curves, acoustical characteristics, finishes, color selection, location and size of field connections, and accessories. Include certified drawings on major equipment such as boilers, water chillers, cooling towers, controls, pumps, and tanks.
   2. Motors: Submit manufacturer's name, type, RPM, HP (KW), full load amps, efficiency, and power factor.
   3. Part Load Performance: Submit equipment data to indicate performance characteristics throughout ranges of possible load conditions.
   4. Include operating weight and location of center of gravity of each item of equipment in manufacturer's cut sheet for purposes of seismic calculation.
   5. Pipes and Pipe Fittings: Submit schedule showing pipe material data, sizes, fitting valve type k factor, working pressure for each service.

E. Test Reports
   1. Manufacturer's Tests

a. Factory Tests: As specified for specific equipment.
b. Field Tests: As specified.

2. System Pressure Tests: As specified under "Testing"article. Test log of pressure tests on each system. Indicate date of test, scope of test, test pressure, duration, and observers.
3. Balancing Reports: As specified under Section 23 05 93.

F. Certification
1. Seismic Restraints: As specified under Sections 23 05 29 and 23 05 48.
2. Controls: As specified under Section 23 09 23.
3. Welding Certificates.
4. Brazing Certificates.

G. Operating and Maintenance Manuals: Include, but not limited to, the following:
1. List of all equipment with Manufacturer's name, model number, and local representative, service facilities and normal channel of supply for each item. Include phone number and address of service facilities
2. System Description: Description of start-up, operating, and shutdown procedures.
3. Controls: Diagrams and description of operation sequence of each system.
4. Equipment: Manufacturer's brochures, ratings, certified shop drawings, lubrication charts and data, parts lists with part numbers, and belt and sheave data. Mark each sheet with equipment identification number and actual installed condition.
5. Materials and Accessories: Manufacturer's brochures parts list with part numbers and lubrication data where applicable. Mark each sheet with equipment identification number or system and location of installation; and to specifically identify which options are provided (in case where data sheet shows multiple options).
6. Certificate of factory tests, field tests and code compliance as specified.
7. Wiring and controls schematics.
8. Trouble shooting directions.
9. Maintenance procedures and frequencies.
10. Description of special tools.
11. Copies of warranties.
12. Safety precautions.
13. Emergency contingencies.

H. Record Documents
1. Comply with the Conditions of the Contract and the requirements of Section 23 05 53.
2. Indicate ductwork mains and branches, size and location, for both exterior and interior; locations of dampers, control devices, filters, and terminal units requiring maintenance or repair.
3. Indicate mains and branches of piping systems, with valves and control devices located and numbered per valve schedule, concealed unions located, and with items requiring maintenance located (i.e. traps, strainers, expansion compensators, vents, etc.). Indicate actual inverts and horizontal locations of underground piping.
4. Indicate equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Identify approved substitutions, Contract Modifications, and actual equipment and materials installed.

I. Samples: When specified under applicable Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.6 SUBSTITUTIONS

A. General:
1. Base manufacturer is indicated in equipment schedules.
2. In Specification, additional acceptable manufacturer(s) may be indicated.
3. Other manufacturers, materials, or methods shall not be used unless approved in writing by the OWNER Representative.
4. The burden of proof as to the equality of any proposed substitute manufacturer, material**,** or method shall be upon the Contractor.
5. The OWNER Representative's decision shall be final.

B. Requests for substitution review and acceptance shall be accomplished by table of comparison listing pertinent features of both specified and proposed materials, such as materials of construction, performance, dimensions, weights, replacement or maintenance access, motor type, horsepower, voltage, phase, service factor. Review of proposed substitutions will not be made until receipt of satisfactory comparison tabulation.

C. Submittal of substitutions shall be limited to one proposal for each type or kind of item, unless otherwise permitted by the OWNER Representative. If first proposed product submittal is rejected, Contractor shall then submit the first-named or scheduled product.

D. Contractor shall be responsible for all costs and coordination due to the substitution, such as impacts on electrical requirements, weight, openings in slabs and roofs, structural framing, housekeeping pad size, etc.

1.7 JOB CONDITIONS

A. Cause as little interference or interruption of existing utilities and services as possible. Schedule Work which will cause interference or interruption in advance with Construction Manager.

B. Examine Contract Documents to determine how other Work will affect execution of mechanical Work.

C. Determine and verify locations of all existing utilities.

D. Arrange for, coordinate, and pay costs incidental to providing utility company services indicated.

E. Establish lines and levels for each system and coordinate with other systems to prevent conflicts and maintain proper clearances and accessibility.

PART 2 PRODUCTS

2.1 PIPE, TUBE AND FITTINGS

A. Refer to individual Division 23 piping sections for pipe, tube, fitting materials joining methods. Comply with governing regulations.

2.2 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Provide welding materials to comply with installation requirements.
   1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Gaskets for Flanged Joints: ASME B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

2.3 PIPING SPECIALITIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service or, if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Dielectric Unions and Flanges
   1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion. Pressure rating equal to or greater than that of nearby valves.
   2. Manufacturer:
      a. B & K Industries, Inc.
      b. Capitol Mfg. Co.; Div. of Harsco Corp.
      c. Rockford-Eclipse Div.
      d. Victaulic.

2.4 PIPE ESCUTCHEONS

A. General: Provide solid (not split-hinged) pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. All escutcheons shall be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid brass or solid sheet brass pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturer: Chicago Specialty, Producers Specialty, Sanitary-Dash.

2.5 MECHANICAL SLEEVE SEALS

A. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

B. Sleeve: To be furnished by same manufacturer of seals; schedule 40 galvanized steel pipe or Century line sleeves, with integral anchor and waterstop collar.

C. Manufacturer: Thunderline Link Seal or Metraflex Metraseal.

2.6 FIRE BARRIER PENETRATION SEALS

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork.
   1. Piping: Provide fire stopping material as specified in Section 07 84 00.
   2. Ductwork: Provide fire damper or fire/smoke damper. For penetrations where fire damper or fire/smoke damper is not required by code, provide fire stopping material as specified in Section 07 84 00.

2.7 FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:
   1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges:
      a. 3-inch and smaller: 0.040-inch/20 gauge thick.
      b. 4 to 6-inch: 0.064-inch/16 gauge thick.
      c. Over 6-inch: 0.079-inch/14 gauge thick.
   2. Steel Pipe: See “Mechanical Sleeve Seals” article.

2.8 MOTORS AND DRIVES

A. Motor controls and power wiring.
   1. Provided as part of Division 26 work, unless indicated otherwise, including motor switches, disconnects, conduit and wiring, except for low voltage control wiring required for temperature controls.
   2. Where equipment is specified with factory pre-wired controls and is furnished instead with components shipped loose, mechanical contractor shall be responsible for coordinating the complete installation and assume any additional costs.
   3. Motor controls, switches and starters provided by Division 23 contractor..

B. Motors
   1. Ball or roller bearing type, high efficiency type, with starting and running characteristics consistent with torque and speed requirements of driven machine.
   2. Use motors rated in accordance with NEMA performance standards to carry full nameplate load continuously at maximum temperature rise of 72 degrees F above ambient with service factor of 1.15.
   3. Motors driven by variable frequency drives shall be rated for inverter duty and shall meet the requirements of NEMA MG-1 part 31.4.4.2.

4. Where substitute manufacturers are provided with different control panels, starters, or electrical characteristics from scheduled equipment, contractor shall coordinate complete installation and assume any additional costs.
5. Do not allow power requirements of driven machine to exceed nominal nameplate rating of motor furnished.
6. Do not include service factor when selecting motor horsepower.
7. Motors exposed to moisture or rain shall be totally enclosed, fan cooled (TEFC). Others may be open drip proof (ODP), unless otherwise indicated.

C. Efficiency
1. Requirements apply to all motors, 1/2 HP and larger, except for refrigeration compressors**,** and for fans which run only in emergency mode, such as chemical exhaust fans.
2. Ratings in accordance with IEEE 112b Rating Method.
3. Motors shall be labeled as NEMA "Premium" Efficient, with efficiencies as follows, based on 1750 RPM.;
   a. Motors with other than 1750 RPM shall be same type motor as would meet requirements for 1750 RPM motors.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2 inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

D. Electrical Spaces: Do not run piping or ductwork through transformer vaults, electrical rooms and other electrical or electronic equipment spaces and enclosures, unless piping or ductwork is for equipment serving that electrical space.

E. Comply with ASME B31.1.

F. Pressures: Do not install piping, valves or piping specialties where exposed to system pressures greater than their rated working pressures.

G. Sloping, Air Venting and Draining
   1. Slope piping as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in direction of flow as follows:

H. Install piping free of sags and bends. Support requirements are specified in Section 23 05 29.

I. Refrigerant: Clean, dehydrate, and cap refrigerant piping. Take care to ensure that entire system is clean and dry during installation. Clean tubing by means of swab saturated in methyl alcohol or refrigerant 12 drawn through tubing as many times as necessary to thoroughly clean and dry interior of tubing and to eliminate formation of copper oxide. Before refrigerant lines are silver brazed, flush all air from tubing and pass slow-running stream of dry nitrogen through system during brazing process. Purge lines completely and maintain nitrogen flow at steady rate of not less than three cubic feet per hour. After brazing, interior of refrigerant lines must be clean and bright.

J. Fittings
   1. Provide standard, manufactured fittings in all cases. Field fabricated fittings are prohibited. Bushings are prohibited on pressure piping.
   2. Weld-O-Lets and Thread-O-Lets may be used for non-galvanized steel piping if main pipe size is at least three standard pipe sizes larger than branch pipe, e.g. 2-inch main and 1-inch branch.
   3. Provide insulating couplings at connections of ferrous piping to non-ferrous piping.

3.2 INSTALLATION OF VALVES

A. General: Except as otherwise indicated, comply with the following requirements:
   1. Install valves where required for proper operation and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
   2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Install globe valves to close against pressure.

D. Install plug valve with seat toward equipment to be isolated.

E. Valve Discharge Piping: Provide discharge pipe to atmosphere from all relief and safety valves, sized with area equal to sum of outlet areas of all valves connected thereto, unless indicated larger.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building.

Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surfaces.

B. Dielectric Unions and Flanges: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

C. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

D. Fire Barrier Penetration Seals: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

3.4 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs.
1. Do not install sleeves through structural members, except as detailed on Drawings, or as reviewed by the OWNER Representative.
2. Install sleeves accurately centered on pipe runs.
3. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run.
4. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation.
5. Pack 100 percent of annular space between sleeve and pipe or pipe insulation. Provide acoustical sealant at each end of pipe sleeve to seal packing in place.
    a. At fire-rated walls, partitions, floors, roofs, and ceilings: Packing shall be through-penetration firestop.
    b. At non-fire-rated walls, partitions, floors, roofs, and ceilings: Packing shall be fiberglass insulation, with density of 1.5 pcf.
6. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves.
7. Extend floor sleeves 1 inch above level floor finish.
8. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
9. Provide temporary closure to prevent concrete and other materials from entering sleeves.

B. Type of Sleeves
1. Install sheet-metal sleeves at walls and partitions.
2. Install schedule 40 pipe sleeves in concrete slabs.
3. Install mechanical sleeve seals at exterior penetrations; below grade, and at slabs-on-grade.

C. Mechanical Sleeve Seals: Install in accordance with the manufacture's instructions.

3.5 PIPING EXPANSION PROVISIONS

A. General: Install domestic hot water piping with at least 4 elbows or tees at following locations.
1. Between piping mains and risers.
2. Between equipment and pump or tank.

3. Between piping main and equipment.

B. Expansion Loops: Fabricate expansion loops as indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Provide pipe anchor and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.
   1. At Contractor's option, pipe anchors may be insulated lugged anchors; Pipe Shields, Inc., Model #C4000 Series. Comply with requirements for insulated pipe supports in Section 23 05 29.
   2. At Contractor's option, pipe guides may be guided insulated pipe supports; Pipe Shields, Inc., Model #B3000 or B7000 Series. Comply with requirements for insulated pipe supports in Section 23 05 29.

3.6 TESTING

A. General: Provide labor and test equipment including test pumps, gauges, instruments and other equipment required. Use test quality pressure gauges, instruments and other equipment required. Use test quality pressure gauges with range of approximately twice test pressure. Use calibrated gauges and instruments.

B. Piping
   1. General: Remove from systems, during testing, equipment which would be damaged by test pressure. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, any previously tested portion shall become a part of any later test of composite system.
   2. Correct leaks by remaking joints with new material; makeshift remedies will not be permitted. Test time accrues only while full test pressure is on system. Test before backfilling, concealing, insulating or making connections to potable water system.
   3. Test Schedule: Test each section of systems at one and one-half times the maximum working pressure of that section, but at not less than scheduled test pressure. Obtain maximum working pressures from the OWNER Representative if not indicated on Drawings. Unless indicated otherwise, scheduled tolerance is "no pressure loss", except that due to temperature change, in 24 hour period.

C. Valves
   1. General Service Valves: Test bonnets for tightness. Test operate from closed-to-open-to-closed position while under test pressure.

D. Hangers and Supports: With systems in normal operation, test hangers, supports and rods to ensure they are plumb and supporting proper share of load. Additionally support systems and equipment that sway, crawl, or vibrate.

E. Ductwork: Comply with the requirements of Section 23 31 13.

F. Ductwork Specialties
   1. Verify fire dampers, fire/smoke dampers, smoke dampers, and two position AVD's (automatic volume dampers) are 100% open, unless damper is indicated to be closed during normal operation.

G. Buried Pipe and Equipment Wrapping and Coating: Test surfaces with standard 8,000 to 10,000 volt electrical holiday detector.

H. Other Materials and Equipment
   1. Rotation: Verify.
   2. Motor Amperage: Verify operating motor amperage does not exceed motor nameplate rating.
   3. Test as specified; as recommended by equipment manufacturer; and as otherwise necessary or directed to assure they are complete, operable, and ready for use.

3.7 ADJUSTING AND CLEANING

A. Inspect all equipment and put in good working order.

B. Clean all exposed and concealed items
   1. Clean air surfaces of all coils, fans (including fan wheels and motors), air handler plenums and air filter frames.
   2. Clean floor drains, cleanouts, and plumbing fixtures.
   3. Clean specialties such as traps and strainers. Replace strainer screens with new prior to system commissioning.

C. Ductwork: Blow-out ducts with fans before connecting terminal units. Clean ducts before installing air outlets.

D. Equipment and Materials: Remove foreign materials including dirt, grease, splashed paint, and plaster, etc. Restore damaged finishes to original condition.

E. Piping: Flush clean interior of piping. Upon completion of flushing, completely drain systems at low points; remove, clean, and replace strainer baskets and refill systems.

F. Gas: After testing of natural gas system, and before any gas is put into line, blow out entire system of piping to remove scale and dirt; purge air by filling system with gas.

G. Adjusting: Adjust equipment and system components as indicated or as otherwise required to result in intended system operation. Thereafter, as a result of system operation, or as directed, make readjustments as necessary to refine performance and to effect complete system tune-up.

3.8 SPECIAL TOOLS

A. Furnish to Owner not later than when OWNER takes possession of equipment.

B. Definition of Special Tools: Identified in or otherwise implied by, the manufacturer's operation and maintenance manuals for the furnished equipment, or which are otherwise required for the operation, with the manufacturer's recommended procedures for operation, adjustment and maintenance. Special tools do not include those required for major repairs normally done by factory trained or otherwise specialized service personnel, nor do they include those normally found in the possession of OWNER's on site maintenance personnel.

3.9 MANUFACTURER'S START-UP ASSISTANCE

A. Where the services of a factory authorized service representative are specified for the start-up of certain pieces of equipment, arrange to have the manufacturer of such equipment perform start-up and check-out service. Manufacturer shall provide a letter which shall be on the manufacturer's letterhead, shall list the equipment, shall certify that the equipment has been examined, that it has been installed in accordance with the manufacturer's installation instructions, started up, adjusted, and checked out in accordance with the manufacturer's instructions, and is operating properly. The letter shall be addressed to the OWNER and shall be signed by an authorized representative of the manufacturer.

3.10 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush clean interior of piping. Inspect each run of each system for completion of joints, supports and accessory items. Upon completion of flushing, completely drain systems at low points; remove, clean and replace strainer baskets and refill systems.
   1. Inspect pressure piping in accordance with procedures of ASME B31.

3.11 ADJUSTING AND CLEANING OF VALVES

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Valve Identification: Tag each valve in accordance with Section 23 05 53.

3.12 EQUIPMENT VIBRATION

A. Mechanical Balance: Fans, pumps, motors, and drives, when equipment is installed and in normal operation, shall be within the following maximum limits, unless specified more restrictively for individual equipment items:
   1. 600 RPM and Less: 0.003-inch displacement, peak-to-peak.
   2. Over 600 RPM: 0.10-inch per second velocity, peak.

B. Pulley Run-Out: When equipment is installed and in normal operation, pulley run-out in radial and axial directions not to exceed 0.001-inch.

C. Field Tests: If requested, test equipment to determine compliance with specified requirements. Measure vibration displacement and velocity in vertical direction relative to floor. Make measurements on bearing housings (not end caps), or other heavy structural element directly connected to bearing housing, at each end of equipment.

D. Field Balancing: Balance and retest equipment as required for compliance with specified requirements.

END OF SECTION 23 05 00

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Pipe Hangers and Supports.
2. Vertical Piping Clamps.
3. Hanger-Rod Attachments.
4. Building Attachments.
5. Pipe Shields.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP 90, Guidelines on Terminology for pipe hangers and supports.

1.3 QUALITY ASSURANCE

A. Manufacturer's qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards
1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. Qualify welding processes and welding operators according to AWS D1.1, Structural Welding Code-Steel.
   a. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
3. Qualify welding processes and welding operators according to ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications.
4. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
   a. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems
   b. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.
5. Licensed Engineer: Prepare hanger and support design drawings and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Structural Engineer licensed in the State of California certifying compliance with Specifications.
6. MSS Standard Compliance:
   a. Provide pipe hangers and supports of which materials design and manufacture comply with MSS SP-58. Select and apply pipe hangers and supports, complying with MSS SP-69.
   b. Fabricate and install pipe Local and supports, complying with MSS SP-89.
   c. Terminology used in this Section is defined in MSS SP-90.

C. Corrosion Resistance: Provide hot-dip galvanized steel, cadmium plating, or other approved corrosion resistant materials for exterior work and for work which will be subject to outdoor exposure during construction.

D. Coordination
   1. Coordinate resiliently supported work with other trades to avoid rigid contact with the building. Inform other trades such as drywall, plastering, or electrical, to avoid any contact which would reduce the vibration isolation.

E. Conflicts and Discrepancies
   1. Bring to the OWNER Representative's attention prior to installation any conflicts with other trades which will result in unavoidable contact to equipment, piping, etc., described herein, due to inadequate spaces, etc. Corrective work necessitated by conflicts after installation shall be at Contractor's expense.
   2. Bring to the OWNER Representative's attention prior to installation any discrepancies between the Specifications and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective work necessitated by discrepancies after installation shall be at Contractor's expense.

F. Inspection and Instruction
   1. Obtain inspection and approval from the OWNER Representative of any installation to be covered or enclosed prior to such enclosure.

1.4 VIBRATION ISOLATION

A. Comply with the requirements of Section 23 05 48.

1.5 SEISMIC RESTRAINTS

A. Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Include the following:
   1. Manufacturer's data (catalog cuts and data sheets), for each manufactured component including hangers, attachments, inserts, thermal shields anchors and guides, auxiliary framing and wall seals. Provide a project specific hanger and support schedule indicating all devices, manufacture and model, where used. Cross reference to product data and specification paragraph. Data shall demonstrate that components comply with Specifications.
   2. Support and Bracing Shop Drawings: Submit plans, sections, details, schedules and other information necessary to describe support hangers for all HVAC systems. Submittal shall indicate location and type of all hangers and supports. Each attachment to the building structure shall have vertical and horizontal point loads identified.
   3. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual in accordance with requirements of Division 1.
   4. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
   5. Shop drawings for each type of hanger and support, indicating dimensions weights, required clearances, and methods of component assembly.
   6. Licensed Engineers hanger and support drawings specified in the "Quality Assurance' Article

7. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

PART 2 PRODUCTS

2.1 GENERAL

A. Where not fully called for in the Contract Documents, design of HVAC hangers and supports shall be the Mechanical Contractor's responsibility. Design shall conform to accepted engineering practice using a safety factor of 2-1/2.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
   1. Superstrut, Gold Galv.
   2. B -Line Systems, lnc.
   3. Fee & Mason Mfg.Co.; Div. Figgie International ITT Grinnel Corp.
   4. Tolco.

2.3 MANUFACTURED HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide felt-lined hangers and supports for copper piping systems in direct contact with copper piping components including galvanized coatings where installed for piping and equipment that will not have a field applied finish. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper piping.

B. Thermal-Hanger Shield Inserts: 100 psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Shield Insert shall cover entire circumference of pipe and be of length indicated by manufacturer for pipe size and thickness of insulation by CSS Pre-Insulated Supports.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated type, drive-pin attachments are not acceptable.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Adjustable Steel Clevises Hangers: MSS Type 1.

F. Yoke Type Pipe Clamps: MSS Type 2.

G. Steel Double Bolt Pipe Clamps: MSS Type 3.

H. Pipe Hangers: MSS Type 5.

I. Adjustable Swivel Pipe Rings: MSS Type 6.

J. Adjustable Steel Bond Hangers: MSS Type 7.

K. Adjustable Band Hangers: MSS Type 9.

L. Adjustable Swivel Rings, Band Type: MSS Type 10.

M. Extension Split Pipe Clamps: MSS Type 12.

N. U-Bolts: MSS Type 24.

O. Clips: MSS Type 26.

P. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
1. Plate: Unguided type.
2. Plate: Guide type.
3. Plate: Hold-down Clamp type.

Q. Makeshift, field devised methods of HVAC pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42.

2.4 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical piping clamps complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide felt-lined or copper-plated clams for copper-piping systems.

B. For vertical mid-span supports of piping 4-inch and under, use Hubbard Enterprises/HOLDRITE Stout Brackets with Hubbard Enterprises/HOLDRITE Stout Clamps or two-hole pipe clamps (MSS Type 26).

C. Two-Bolt Riser Clamps: MSS Type 8.

D. Four-Bolt Riser Clamps: MSS Type 42.

2.5 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.6 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Powder-actuated fasteners are not acceptable.

B. Concrete Inserts
1. Post-Installed Anchors: Proprietary type, designed for intended uses, and ICC ESR evaluated.
   a. Manufacturers
      1) ITW Ramset/Red Head.
      2) Simpson.
      3) Hilti Co.

C. Steel Brackets: One of the following for indicated loading:
1. Light Duty: MSS Type 31.
2. Medium Duty: MSS Type 32.
3. Heavy Duty: MSS Type 33.

D. Side Beam Brackets: MSS Type 34.

E. Plate Lugs: MSS Type 57.

F. Horizontal Travelers: MSS Type 58.

G. Powder-Actuated Fasteners: Not allowed.

2.7 INSULATED PIPE SUPPORTS (PIPE SHIELDS)

A. All insulated lines shall be protected at the point of support by insulated pipe supports provided and installed by the pipe erector.

B. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes:
1. ASME B31.1, MSS SP-58, MSS SP-69, and MSS SP-89.

C. Manufacturer: Pipe Shields Incorporated (PSI); B-Line.

D. Insulated Pipe Supports
1. Pipe supported on rod hangers PSI, Michigan, B-Line.
2. Pipe supported on Flat Surfaces PSI, Michigan, B-Line.
3. Pipe supported on pipe rolls PSI, Michigan, B-Line.
4. Pipe Guides PSI, Michigan, B-Line.
5. Anchors PSI, Michigan, B-Line.
6. Riser Pipe Supports PSI, Michigan, B-Line.

E. Insulation
   1. 360-degrees insulation, encased in 360-degrees sheet metal shield.
   2. Provide assembly of same thickness as adjoining pipe insulation.
   3. Insulating Material:
      a. Cold Piping (below 50 degrees F): Urethane foam, 100 psi compressive strength.
      b. Hot piping (above 50-degrees F): Calcium silicate, 100 psi compressive strength, treated with water repellent.

2.8 MISCELLANEOUS MATERIALS

A. Auxiliary Steel:
   1. Provide auxiliary structural steel as required for supports, anchors, guides, seismic restraints and vibration isolators.
   2. All structural steel systems to be designed in accordance with AISC Steel Handbook.
   3. All systems to be secured to building structure in a method acceptable to and approved by the Project Structural Engineer.
   4. Steel Work: Fabricate neatly. Grind off excess burrs and welding spatter. Paint with rust inhibitive primer.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A36.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No.2). Mix at a ratio of 1.0 part cement to 2.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS Standards.

E. Pipe Alignment Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.
   1. Manufacturers
      a. Hyspan.
      b. Metraflex.

PART 3 EXECUTION

3.1 GENERAL

A. Install devices in accordance with manufacturer's recommendations.

B. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

C. Support of pipe tubing and equipment shall be accomplished through means of engineered products specific to each application. Makeshift field devised methods will not be allowed.

D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the Work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated Work, Installer shall meet at Project site with Contractor, Installer of each component of associated Work, Inspection and testing agency representatives (if any), Installers of other Work requiring coordination with Work of this Section and the OWNER Representative for purpose of reviewing material selections and procedures to be followed in performing the Work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

B. Cast-in Place Concrete Inserts
   1. Install before concrete is placed. Fasten inserts securely to forms.
   2. Install with reinforcing bar through opening at top of insert or with steel plate to distribute load, as detailed on Drawings.
   3. Maximum load per insert in slabs shall be 200 pounds, with a minimum spacing of 5 feet in any direction. For loads greater than 200 pounds, or where spacing cannot be maintained, make attachment to building structure or auxiliary steel, rather than to slab.

C. Concrete Wedge Anchor Inserts: Maximum tension load per insert shall not exceed manufacturer's published rating.

D. Powder-Actuated Fasteners: Not allowed.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports of smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Install in accordance with Seismic Restraint manual Guidelines for Mechanical Systems (SMACNA).
   1. Materials, design and type numbers per MSS-58.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, felt-lined.

D. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.1 Power Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements:
1. Provide insulated pipe support (pipe shield) at each support of insulated piping.
2. Select model of insulated pipe support according to published recommendations of insulated pipe support manufacturer, based on pipe size, pipe material, fluid medium, fluid temperature, support spacing, and type of support.
3. Submit tabulation showing proposed uses of insulated pipe supports for different applications.

H. Provide pipe supports on all DWV vertical piping penetrating floor slabs.

I. All hanger components shall be Superstrut Gold Galv.
1. Vertical Piping: Superstrut clamps attached to the pipe above each floor to rest on the floor. Provide copperplate on copper tubing. Provide additional support at base of cast iron risers. Provide intermediate support for vertical piping greater than 12 feet in length.
2. Individually Suspended Piping: Superstrut J-Hanger or Clevis, complete with threaded rod. Copper pipe will be used in conjunction with felt lined hangers.

Pipe Size	Rod Size
2-inch and Smaller	3/8-inch
2-1/2-inch to 3-1/2-inch	1/2-inch

3. Provide 3/8 inch or support of PVC and CPVC and provide continuous support.
4. Trapeze Suspension: Superstrut 1-5/8-inch width channel in accordance with manufacturer's published load ratings. No deflection to exceed L/180 of a span.
5. Trapeze Supporting Rods: Shall have a safety factor of 5; securely anchor to building structure.
6. Pipe Straps: Superstrut 702 isolate copper pipe with two thicknesses of 2-inch wide 10-mil polyvinyl tape (Cush-A-Strip or Cush-A-Clamps). Where used for seismic support systems, provide Superstrut 702 series pipe straps.

J. Concrete Inserts: Superstrut C302 continuous insert or 452-TB spot insert. Do not use powder-actuated fasteners for support of overhead piping unless approved by the OWNER Representative.

1. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
2. Install concrete inserts in new construction prior to placing concrete. Superstrut 452-TB.
3. Install post-installed concrete anchors after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

K. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

L. Rubber Neoprene Pipe Isolators
1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Architectural Drawings shall show location of acoustical walls.
2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. Superstrut.

M. Pipe Hangers and Support Spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and space at or within following maximum limits. Note that spacing listed are recommended maximums; increased spacing requirements due to California Building Code requirements, CCR Title 24, or other regulations in force and applicable for this contract shall be adhered to.

Pipe Diameter	Steel Fluid	Steel Vapor	Copper Fluid
1/2 to 1-inch	6	8	6
1-1/4 to1-1/2-inch	8	10	6
Over 2-inch	10	10	10

N. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

O. Provide rigid insulation and a 12-inch long, 18 gauge galvanized sheet metal shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering or CSS Pre-Insulated Calcium Silicate Support.

P. Insulate copper tubing from ferrous materials and hangers with felt lined hangers.

Q. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

R. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power-actuated fasteners will not be allowed.

3.5 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint and exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA1 requirements for touching up field-painted surfaces.
   1. Apply by brush or spray to provide a 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 A780.

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Structural Engineer, licensed in the State of California, certifying compliance with Specifications.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Vibration Isolators.
2. Seismic Restraints.
3. Flexible Connectors.

1.2 REFERENCES

A. ASHRAE - Guide to Average Noise Criteria Curves.

1.3 QUALITY ASSURANCE

A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.

B. All items of a given type shall be the product of the same manufacturer.

C. Provide necessary design for avoidance of excessive noise and vibration in building due to operation of machinery or equipment, or due to interconnected piping or conduit.

D. Installation of all vibration isolation units, and associated hangers and bases, shall be under direct supervision of vibration isolation manufacturer's representative.

1.4 REGULATORY REQUIREMENTS

A. Provide seismic restraints for pipes and equipment, including pipes above roofs, supported from below in accordance with the requirements of the California Code of Regulations, Title 24, Parts 3, 4, and 5.

1.5 SUBMITTALS

A. Submit in accordance with Sections 01 33 00.

B. Shop drawings and product data; submittal shall include:
1. Concrete and steel details for equipment.
2. Vibration isolation devices: Catalog cuts, isolation efficiencies and rated static deflections.
3. Welds or anchor bolt locations.
4. Reinforcing and template steels.
5. Number and locations of seismic restraints for each piece of equipment; specific details of restraints including anchor bolts for mountings and maximum load at each location.
6. Spring O.D., free operation, and solid height of springs and ratio of horizontal to vertical stiffness.
7. Number and location of vibration isolators for each piece of equipment including actual operating load for each vibration isolator.

C. Seismic calculations for each seismic restraint sized and signed by registered Structural Engineer licensed in the State of California.

D. Manufacturer's installation instructions.

E. Manufacturer's Installation Report as specified in the "Field Quality Control" Article.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers
1. Mason Industries, Inc.
2. Vibration Mountings and Controls, Inc.

B. Manufactured Units.
1. Isolator Type "PN"; three layers of 1/4-inch neoprene waffle pad bounded between 16 gauge sheet metal shims or 3/4-inch thick neoprene waffle pad consisting of 2-inch square modules separated by thin web. Load distribution top plate utilized as required with additional 1/5 inch thick washer and bushing when pads are anchored to structure.
2. Isolator Type "MS": Spring type, free standing and laterally stable without any housing, complete with 1/4-inch neoprene acoustical friction pad or neoprene cup between base plate and support. Provide leveling height and solid spring height in submittals.
3. Isolator Type "MSL": Spring type mountings designed to resiliently resist seismic forces in all directions. Snubbing in all modes with adjustment to limit upward, downward and horizontal travel to a maximum of 1/4 inch before contacting snubbers. Provide spring with same characteristics as described in Type MS mountings. Provide mountings with leveling bolts that must be rigidly bolted to equipment, and with ports or openings to verify possible overload conditions. In submittals include spring diameter, deflections, compressed spring height and solid spring height.
4. Isolator Type "HN": Vibration hangers which contain minimum .35-inch static deflection neoprene element. Neoprene rod isolation bushing shall pass through hanger box lower hole to prevent metal to metal contact.
5. Isolator Type "HS": Vibration hangers which contain steel spring seated in 1/4-inch thick neoprene cup with integral rod isolation bushing. Bushing shall pass through lower hanger box hole to prevent metal-to-metal contact. Provide spring diameters and hanger box lower hole sizes large enough to permit hanger rod to swing through 30 degree arc. Provide minimum additional travel to solid equal to 50 percent of rated deflection.

2.2 SEISMIC RESTRAINTS

A. Manufacturers
1. Midland-Ross Superstrut.
2. B-Line.

B. Restraint Types
1. Type R-1: Provide directional seismic restraints with interlocking steel members restrained by replaceable, minimum 1/4-inch thick bridge bearing neoprene bushing, capable of rotation after installation to verify isolation system is out of contact with restraints. Incorporate minimum air gap of 1/8 inch in snubber design in all directions before contact is made between rigid and resilient surfaces.

2. Type R-2: Restraints of all isolated suspended piping, ductwork and equipment using steel cables arranged to achieve required all-directional restraint and sized to resist seismic loads. Indicate proposed method of achieving sufficient slack to avoid short circuiting vibration isolators in submittal drawing.

C. General Requirements
1. Provide seismic restraints for all vibration isolated equipment, ductwork and piping.
2. Restrain supported and suspended equipment and piping by devices capable of restraint in all three mutually orthogonal directions.
3. For suspended equipment, utilize stranded steel aircraft cable plus modifications to isolators to prevent excessive vertical motion.
4. Seismic restraints must be installed and adjusted so equipment and piping vibration isolation is not degraded by utilization of restraints.

2.3 FLEXIBLE CONNECTORS

A. Manufacturers
1. Mason Industries, Inc.
2. Amber Booth.

B. Neoprene Connectors
1. Use flexible EPDM connectors on equipment as indicated on drawings or on equipment schedule, manufactured of multiple layers of frictioned nylon cord with EPDM cover and liner. Do not use steel wire or rings as internal pressure reinforcement. Provide straight connectors with two spheres with a centered molded external ductile iron ring to maintain two spherical shapes. Two inch and smaller sizes may have threaded ends. Provide floating flanges with recess to lock bead wire in raised face EPDM flanges. Use tapered twin sphere connectors as described above where line size changes are required in straight piping runs.
2. Flanged equipment may be directly connected to neoprene elbows in size range 2-1/2 to 12 inches, if piping makes 90 degree turn and flanges are equal sized. Long radius reducing EPDM elbows may be used in place of steel or cast iron elbows at pump connections.
3. When pressure would cause connector to extend beyond its rated elongation, employ control rods using 1-1/2-inch thick bridge-bearing neoprene washer bushings designed for maximum loading of 1000 psi.
4. Provide twin sphere connectors with minimum rating of 250 psi at 170 degree F and 165 psi at 250 degree F. Provide elbows and reducing twin spheres with minimum pressure rating of 220 psi at 170 degree F and 145 psi at 250 degree F. Limit neoprene materials to 220 degree F. Certified safety factors shall be a nominal 4 to 1 with minimum acceptable test results of 3.6 to 1. Tests shall cover burst, flange leakage, extension without control rods and flange retention at 50 percent of burst pressure without control rods.
5. Include in submittals test reports by independent consultants showing minimum reduction of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

C. Flexible Stainless Steel Hose
1. Provide flexible stainless steel hose with stainless steel braid and carbon steel fittings. Provide flanged fittings for sizes 3-inch and larger, and make nipples for smaller sizes. Use bronze braided flexible hose with female sweat ends for copper lines. Install hoses

on equipment side of shut-off valves horizontally and parallel to equipment shafts whenever possible. Flexible metal hose shall be Type BSS or BFF.

PART 3 EXECUTION

3.1 GENERAL

A. Isolate plumbing equipment from building structure by means of noise and vibration isolators.

B. Install isolators in accordance with manufacturer's written instructions.

C. Vibration isolators must not cause change of position of equipment or piping resulting in piping stresses or misalignment.

D. Make no rigid connections between equipment and building structure that degrade noise and vibration isolation system.
   1. Loop electrical conduit connections to isolated equipment to allow free motion.

E. Do not use isolator leveling bolts as jacking screws.

F. Verify that installed isolators and mounting systems permit equipment motion in all directions.

G. Install vibration isolators for motor driven equipment.

3.2 SEISMIC CONTROL

A. Provide seismic restraints for pipes and equipment per CBC, CMC, and CPC, including pipes above roofs, supported from below.

B. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift.

C. Provide approved resilient restraining devices as required to prevent equipment and piping motion in excess of 1/4 inch.

D. Provide capability of safely accepting external forces without failures.

E. Do not short circuit vibration isolation systems or transmit objectionable vibration or noise.

F. Provide restraint for piping in mechanical rooms for pipe sizes covered by SMACNA.

G. Designs: Where designs, etc., are neither indicated nor referenced, submit such designs, together with supporting calculations prepared by Structural Engineer registered in the State of California. Calculations shall substantiate seismic restraint capability to safely accept external forces without failure and maintain equipment in position.

H. Rigidly Supported Piping
   1. Where required for all systems, except sprinkler piping system, restrain per SMACNA seismic standards.

I. Flexibly Supported Piping
   1. Provide and locate restraints to allow normal operation of systems without transmitting vibrations to building structure.
   2. Locations of Restraints: Per SMACNA and Factory Mutual where applicable.
   3. Construction of Restraint: Steel cables, installed slack, may be used.

3.3 EQUIPMENT ISOLATION AND SEISMIC CONTROL

A. Position equipment and structural base on blocks or wedges at proper operating height. Set steel bases for 1-inch clearance between pad and base. Set concrete bases for 2-inch clearance.

B. Provide operating load conditions prior to transferring base isolator loads to springs and remove wedges.

C. Adjust or provide additional resilient restraints to flexibly limit startup equipment lateral motion to 1/4 inch.

D. Prior to startup, clean out all foreign matter between bases and equipment.

E. Verify that there are no isolation short circuits in the base, isolators or seismic restraints.

F. Position all corner or side seismic restraints with equipment operating for proper operating clearance.

3.4 PIPING ISOLATION AND SEISMIC RESTRAINT

A. Isolate piping outside of shafts as follows:
   1. Water piping 1-1/4 inch and larger in mechanical equipment rooms: Within 50 feet or 100 pipe diameters whichever is smaller, of connected rotating equipment and pressure reducing stations.
      a. Piping where exposed on roof.

B. Provide spring isolators on piping connected to isolated equipment as follows:
   1. Up to 4 inches in diameter, first 3 points of support.
   2. 1.5 to 8 inches in diameter, first 4 points of support.
   3. 10 inches and over in diameter, first 6 points of support.
   4. Static deflection of first point shall be twice deflection of isolated equipment.

C. Locate Isolators:
   1. Close to building structure.
      a. Hanger boxes butted to ceiling structure.
   2. Between building structure and supplementary steel if required.

D. Supplementary steel to be sized for maximum deflection of 0.08 inches at center span.

E. Seismic restraint spacing shall be in accordance with specified hanger spacing.

F. Provide Seismic Restraint For All Piping:
   1. In equipment room.
   2. On roofs.
   3. In shafts and in ceiling of occupied spaces.

3.5 FIELD QUALITY CONTROL

A. Provide inspection by manufacturer's representative of all vibration isolating devices after installation of all devices.

B. Submit written report by manufacturer regarding installation error, improper selection of devices, and other faults that could affect performance of system. Include report on steps to properly complete isolation work.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe Markers.
2. Valve Tags.
3. Equipment Nameplates.
4. Underground Marking Tape.
5. Duct Lables.

1.2 REFERENCES

A. ASME A13.1-2015 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Indicate model, type, and application usage.

C. Submit list of wording, symbols, letter size**,** letter style, and color coding for each system and vault cover.

D. Submit valve numbering scheme**,** valve chart and schedule, including valve tag number, location, function type, and valve manufacturer's name and model number.

1.4 COORDINATION

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations and valve and equipment numbering schemes prior to submittal review.

B. Coordinate installation of identifying devices with completion of covering of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment. If not installed before ceiling is installed, the Contractor shall remove ceiling at no additional cost to the Owner and install identifying devices.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seton Name Plate Corp.

B. Brimar.

C. Brady.

2.2 PIPE MARKERS

A. Markers: ASME A13.1.
1. Pressure sensitive vinyl (self sticking) material.
2. Mechanically fastened type: Snap on or strap on.
   a. For dirty, greasy, or oily pipe where pressure sensitive markers may not perform satisfactorily.
3. All weather film for outdoor exposed piping.
4. Provide 360 degree and pipe flow arrows and fluid being conveyed.
5. Size of letters legend:

OUTSIDE DIAMETER OF PIPE OR PIPE COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS AND ARROWS
3/4 to 1-1/4 inch	8 inch	1/2 inch
1-1/2 to 2 inch	8 inch	3/4 inch
2-1/2 to 6 inch	12 inch	1-1/4 inch
Ductwork		2-1/2 inch

2.3 VALVE TAGS

A. Tags: Brass or anodized aluminum type.
1. Brass: Minimum 19 gauge, polished, 2-Inch diameter with following lettering:
   a. Service: ¼-inch stamped black filled letters.
   b. Valve numbers: 3/8-inch stamped black filled letters.
2. Aluminum: 2-inch diameter, 0.032-inch thick, with following lettering:
   a. Service: ¼-inch engraved letters.
   b. Valve numbers: 3/8-inch engraved letters.

B. Fasteners: 4 ply 0.018 copper or monel wire meter seals, brass “S” hooks or No. 16 brass jack chain.

2.4 EQUIPMENT NAME PLATES

A. 1/8-inch rigid plastic or bakelite with 4 edges beveled, with black background and white border and letters.
1. Two 3/8-inch mounting holes.
2. Minimum ½-inch high lettering.
3. Commercial quality, rust resisting nuts and bolts with backwashers, self tapping screws or rivets.

2.5 UNDERGROUND MARKING TAPE

A. General: Provide underground pipe marking tape on all pipes buried beneath the ground. Provide a continuous length of tape 12 inches below the finished earth surface directly above the buried pipe. Provide a second continuous length of tape 12 inches above the top of the

buried pipe if the top of the pipe is lower than 36 inches from the top of the finished earth surface.

B. Tape: 5 mil inert plastic film for underground use.

C. Resistant to alkalis, acids and other destructive agents found in soil; information in the Geotechnical Report.

D. Minimum tensile strength: 120 pounds per 6-inch width.

E. Minimum elongation: 500 percent.

F. Provide detectable underground tape above all buried pipes on the Project. Provide a continuous printed message repeated every 16 to 36 inches warning of pipe buried below similar to (i.e., “CAUTION FIRE LINE BURIED BELOW”).

G. Color code:
1. Yellow: Natural gas.

H. Provide tape widths of 2, 3, 6, 9, and 12 inches for lines buried 10, 20, 30, 40, and 50 inches or greater, respectively.

2.6 DUCT 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: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 degrees 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. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, 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.
2. Lettering Size: At least 1-1/2 inches high.

2.7 STENSILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4-inches for ducts; and minimum letter height of ¾-inch for access panel and door labels, equipment lables, and similar operational instructions.3
   1. Stencil Material: Aluminum.
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.8 CHART AND DIAGRAM FRAMES

A. Chart and diagram frames: Extruded aluminum with plexiglass or glass windows.

2.9 GAS VAULT

A. Provide identification on vault cover. Label cover to read “MAIN GAS SETTLEMENT JOINT AND SUMP PUMP.” Use 4 inch high helvetica medium upper case letters in black enamel paint stenciled on the vault cover. Contractor to coordinate with OWNER Representative type of identification for vault cover prior to submittal review.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 VALVE AND EQUIPMENT IDENTIFICATION

A. Designate all equipment, valves, dampers and terminal units by distinguishing numbers and letters on charts and/or diagrams.
   1. Tag and locate following equipment items:
      a. Valves.
      b. Dampers.
      c. All items indicated on equipment schedules except registers, grilles and diffusers.
   2. Designation shall match that indicated.

B. Install tags on all devices with numbers and letters corresponding to charts.

C. Fasten tags securely to devices with tag fasteners in manner for easy reading.

D. Attach equipment nameplates in conspicuous location, directly on item of equipment or apparatus such as starters, pumps, fans, HVAC units and control panels.

E. For unsuitable surfaces, such as high temperature or lack of space, use copper or brass rings or chains to attach tags.

F. Furnish 4 charts.
   1. Mount 1 chart in frame and secure on wall in location directed by OWNER Representative.
   2. Include remaining 3 sets in “Operation and Maintenance Manuals”.
   3. Show valve tag numbers on project as-built drawings.

G. Provide safety sign for each piece of exposed mechanical equipment that may start automatically. Comply with the requirements of Section 10 14 00.

3.3 PIPE IDENTIFICATION

A. Locate pipe markers as follows:
1. Next to each valve and fitting, except on plumbing fixtures and equipment.
2. At each branch or riser take off.
3. At each passage through walls, floors and ceilings.
4. At each pipe passage to underground.
5. On all horizontal pipe runs every 20 feet, at least once in each room and each story traversed by piping system.
6. Identify piping contents, flow direction, supply and return.

B. Install markers with tape color bands over each end of marker, extending around pipe and overlapping a minimum of 30 degrees.

3.4 SERVICE ABBREVIATIONS

A. Coordinate with OWNER Representative for preferred color schemes and service abbreviations as indicated below:
1. G (xxx psi) Natural Gas (indicate pressure).
2. REF Refrigerant (exposed)

3.5 INSTALLATION OF UNDERGROUND MARKING TAPE

A. Install underground marking tape directly above all outside utility lines.

B. Allow 12 inches between tape and line, and install as close to grade level as feasible.

3.6 CONTROL DIAGRAMS AND INSTRUCTIONS

A. Provide HVAC control and systems instructions and diagrams in wall mounted frames. Mount framed diagrams in conspicuous, easily accessible places in equipment rooms housing appropriate HVAC system.

B. Diagrams and instructions may be reduced in size provided they are legible and lettering is not smaller than “elite” type of standard typewriter.

3.7 DUCTWORK IDENTIFICATION

A. Install self-adhesive 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.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer’s option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

C. Access doors: Provide duct labels or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Testing, adjustment, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.
3. Sound measurement of equipment operating conditions.
4. Vibration measurement of equipment operating conditions.
5. Flow testing and balancing of following systems:
   a. Domestic water systems.

1.2 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

B. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.3 TOLERANCES

A. Adjust air handling systems to plus or minus 5 percent for supply, return and exhaust systems from figures indicated.

B. Indicate system air leakage loss. Loss shall not exceed 3 percent.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Name of adjusting and balancing agency for approval within 30 days after award of Contract.

C. Test Reports: Report Forms.
1. Submit reports on AABC National Standards for Total System Balance or NEBB forms.
2. Forms shall include the following information:
   a. Title Page:
      1) Company name, address, telephone number.
      2) Project name, location.
      3) Project Architect
      4) Project Engineer
      5) Project Contractor
      6) Project Altitude
   b. Instrument List:
      1) Instrument description; manufacturer; model; serial number; range; calibration date.
   c. Air Moving Equipment:
      1) Location; manufacturer; model; air flow, specified and actual; return air flow, specified and actual; outside air flow, specified and actual; total static pressure

(total external), specified and actual; inlet pressure; discharge pressure; fan RPM.

d. Exhaust Fan Data:
   1) Location; manufacturer; model; air flow, specified and actual; total static pressure (total external), specified and actual; inlet pressure; discharge pressure; fan RPM.

e. Return Air/Outside Air Data:
   1) Identification/location; design air flow; actual air flow; design return air flow; actual return air flow; design outside air flow; actual outside air flow; return air temperature; outside air temperature; required mixed air temperature; actual mixed air temperature; design outside/return air ratio; actual outside/return air ratio.

f. Electric Motors:
   1) Manufacturer; HP/BHP; phase, voltage, amperage; nameplate, actual, no load; RPM; service factor; starter size, rating, heater elements.

g. Air Distribution Test Sheet:
   1) Air terminal number; room number/location; terminal type; terminal size; area factor; design velocity; design air flow; test (final) velocity; test (final) air flow); percent of design air flow.

h. Cooling Coil Data:
   1) Identification/number; location; service; manufacturer; air flow, design and actual; entering air DB temperature, design and actual; entering air WB temperature, design and actual; leaving air DB temperature, design and actual; leaving WB temperature, design and actual; air pressure drop, design and actual.

i. Sound Level Report:
   1) Location; octave bands - equipment off; octave bands - equipment on.

j. Vibration Test:
   1) Location of points:
      a) Fan bearing, drive end.
      b) Fan bearing, opposite end.
      c) Motor bearing, center (if applicable).
      d) Motor bearing, drive end.
      e) Motor bearing, opposite end.
      f) Casing (bottom or top).
      g) Casing (side).
      h) Duct after flexible connection (discharge).
      i) Duct after flexible connection (suction).
   2) Test readings:
      a) Horizontal, velocity and displacement.
      b) Vertical, velocity and displacement.
      c) Axial, velocity and displacement.
   3) Normally acceptable readings, velocity and acceleration.
   4) Unusual conditions at time of test.
   5) Vibration source (if non-complying).

k. Prior to commencing work, draft reports indicating adjusting, balancing, and equipment data required.

l. Draft copies of report for review prior to final acceptance of Project. Provide final copies for OWNER Representative and for inclusion in operating and maintenance manuals.

m. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
n. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

D. Closeout Submittals.

E. Project Record Documents:
1. Submit record documents under provisions of Division 1.
2. Accurately record actual locations of balancing valves and rough setting.

1.5 QUALITY ASSURANCE

A. Agency shall be company specializing in adjusting and balancing of systems specified in this Section with minimum three years documented experience certified by AABC. Perform Work under supervision of AABC Certified Test and Balance Engineer or registered Professional Engineer.

B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

C. Pre-Installation Meetings:
1. Convene a conference two weeks prior to commencing work of this Section, under provisions of Division 1.

1.6 SEQUENCING AND SCHEDULING

A. Sequence work under provision of Division 1.

B. Sequence work to commence after completion of systems, and schedule completion of work before Substantial Completion of Project.

C. Provide assistance in final adjustment and test of smoke control system with Fire Authority.

1.7 TESTING AND STARTUP PROCEDURE

A. The following procedures shall be used for starting and testing of each item of equipment.

B. Prior to testing and/or starting, clean inside each piece of equipment and provide clean filters and strainers. OWNER Representative will inspect.

C. Prior to equipment startup, submit in writing to OWNER Representative approval to begin Checking Equipment/Test Procedure and Startup Procedure. Submit manufacturer's recommendations for startup/testing.

D. Checking Equipment/Test Procedure:
1. Fans:
a. Record serial numbers, model, brand, etc.
b. Lubricate where necessary.
c. Check belts.
d. Check rotation.

e. Check voltage and phase.
f. Check for free movement.
g. Turn fan on and begin testing.

2. Split Systems/Heat Pumps:
   a. Record serial numbers, model, brand, etc.
   b. Lubricate where necessary.
   c. Check rotation.
   d. Check voltage and phase.
   e. Check for free movement.
   f. Evacuate lines as per manufacturer's recommendations and hold to 48 hours without leak.
   g. Request the presence of a OWNER Representative.
   h. In the presence of a OWNER Representative:
      1) Demonstrate that the lines have been evacuated to the recommended micron level and are holding without leaks.
      2) Turn on vacuum pump, close valve on pump and turn pump off.
      3) Demonstrate that lines are holding a vacuum.
   i. Open suction and liquid valves.
   j. Turn unit on.
   k. Install gages and add a small amount of refrigerant if necessary to compensate for the line length and evaporator coil.
   l. Begin testing unit.

E. Startup Procedure:
1. Fans:
   a. Check control sequence of fan. Check interlocks.
   b. Correct deficiencies.
   c. Request the presence of a OWNER Representative and control Subcontractor for startup test.
   d. In the presence of a OWNER Representative:
      1) Check control sequence of fan. Check interlocks.
2. Split Systems/Heat Pumps:
   a. Initiate test mode outlined in factory startup manual to verify defrost cycle.
   b. Turn system to automatic operation at thermostat.
   c. Check that unit cools, heats and fan runs.
   d. Request the presence of a OWNER Representative and Control Subcontractor for startup test.
   e. In the presence of a OWNER Representative:
      1) Turn unit off.
      2) Set time clocks to manual mode.
      3) Turn unit back on.
      4) Initiate test mode outlined in factory startup manual to verify defrost cycle.
      5) Turn system to automatic operation at thermostat.
      6) Check that unit cools, heats and fan runs.
      7) Replace all covers on unit and put time clock in automatic mode.
   f. If all items are found satisfactory, unit is turned into 5-day test:
      1) Run system at 60 degrees F cooling for 24 hours regardless of seasonal load and system design.
      2) Run system at 80 degrees F heating for 24 hours regardless of seasonal load and system design.

3) Run system at indoor design temperature for 72 hours using a temperature recorder.

g. If system satisfies above set of requirements, system is deemed satisfactory.

h. Verify with OWNER Representative for actual room temperature required during heating and cooling.

F. Where equipment and components are interlocked into a system, test and verify proper operation as a complete system.

PART 2 PRODUCTS

2.1 GENERAL

A. Products and materials shall be as described in pertinent sections of Division 23.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:

1. Equipment is operable and in safe and normal condition.
2. Control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fan rotation is correct.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized.

B. Report any defects or deficiencies noted during performance of services to OWNER Representative.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Commencement of work indicates acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to OWNER Representative to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 ADJUSTING

A. Adjust work under provisions of Division 1.

B. Recorded data shall represent actually measured, or observed condition.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. Air System Procedure
1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
2. Make air quantity measurements in ducts by Pilot tube traverse of entire cross sectional area of duct.
3. Measure air quantities at air inlets and outlets.
4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
5. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
6. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Set minimum position for outside air dampers to achieve indicated minimum outside air CFM's.
10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
11. Take sound level reading at two diffusers per zone at approximately 5 feet above floor. Readings shall be between 43 and 41 db.

3.4 CONTROL COORDINATION

A. Cooperate with control system installer and equipment installer in making adjustments to equipment as required to accomplish indicated performance.

B. Assist in the testing of the chemical agent mode controls in Housing Buildings, to verify that all required fans and dampers position automatically and properly in response to system commands.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Acceptable Manufacturers.
2. Piping Insulation and Jacketing Materials.
3. Insulation Materials.
4. Equipment Insulation Materials.

1.2 QUALITY ASSURANCE

A. Manufacturer's qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this Project.

C. Flame/smoke ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

D. Insulation on pipes, ducts, and plenums in building spaces shall not breed or promote microbial growth.

E. Insulation products shall be formaldehyde-free.

F. K Values: Thermal conductivity in BTU-in/hr. sq.ft. deg.F.

G. Density: In pound/cu.ft. (pcf).

H. Vapor Permeability, in perms: (0.02 perms = 0.02 grains/hr x sq. ft x inch Hg.)

1.3 SUBMITTALS

A. Product data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from Project site.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
1. Armacell.
2. CertainTeed Corp.
3. Johns Manville Corp.
4. Owens-Corning Corp.

2.2 PIPING INSULATION MATERIALS

A. Fiberglass piping insulation: Preformed, one piece, with all service jacket/self sealing lap; K value of 0.23 at 75°F (33.1 at 24°C mean temperature) mean temperature.
1. Vapor Barrier Jacket: With integral, factory-applied, paintable, white reinforced kraft outer surface bonded to aluminum foil with self-sealing lap. Maximum vapor permeance of 0.02 perms, and minimum beach puncture of 50 units.

B. Elastomeric Foam Piping Insulation: Closed cell. K-value of 0.27 or less at 75°F (39 or less at 24°C) mean temperature . Maximum vapor permeance of 0.08 perms. Meet 25 flame / 50 smoke rating for thicknesses up to 1.5 inch. Insulation shall be CFC free.
1. Pipe sizes up to 6": Preformed, one-piece insulation. Armacell AP/Armaflex, Rubatex Insul-Tube 180, or approved equal.

C. Jackets:
1. Interior Applications:
   a. Vapor Barrier Jackets: Kraft, reinforced foil vapor barrier with self-sealing adhesive joints.
   b. PVC Jackets: One piece, premolded type.
   c. Canvas Jackets: UL listed treated cotton fabric, 6oz/sq. yd.
2. Exterior Applications:
   a. Aluminum Jackets: ASTM B209, 20 mils thick; with 2 joint longitudinal seams, and factory supplied butt straps.

D. Fittings and Valves: Manville Zeston, Speed-Line. Premolded PVC fitting covers over pre-cut insulation of same thickness as adjacent piping. Do not use for engine exhaust piping.

E. Bands, wires, and cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, sealers, and protective finishes: As recommended by insulation manufacturer for applications indicated.

2.3 DUCTWORK INSULATION MATERIALS

A. Duct Wrap with Vapor Barrier: 1.5 inch thick fiberglass; 0.75 lb/cu. ft.. R-value of 5.2 at 75°F mean temperature (0.92 at 24°C mean temperature); installed R-value of 4.2. With factory-applied FSK (foil scrim kraft) facing with maximum vapor permeance of 0.02 perms. Formaldehyde free.

B. Elastomeric Foam Duct Insulation: Closed Cell. K-value of 0.27 or less at 75°F (39 or Less at 24°C) mean temperature. Maximum vapor permeance of 0.08 perms. Meet 25 flame / 50 smoke rating for thickness up to 1.5 inch. Insulation shall be CFC free.
1. Sheet and Roll: Armacell AP, Rubatex Insul-Sheet 1800.

C. Fire Wrap Duct Insulation: 2 inch thick. Thermal Ceramics Firemaster, 3M Firemaster, or Certainteed Flamecheck.

D. Ductwork insulation accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork insulation compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.4 EQUIPMENT INSULATION MATERIALS

A. Rigid fiberglass equipment insulation: 6 lb./cu.ft. insulation board; All Service Jacket; K value of 0.22 at 75 degrees F mean temperature mean temperature.

B. Flexible equipment insulation:
1. Johns Manville Micro-Flex APT Jacket. K value of 0.24 at 75 degrees F mean temperature.
2. Elastomeric Foam: Closed cell sheet and roll. K-value of 0.27 or less at 75 degrees F mean temperature. Maximum vapor permeance of 0.08 perms. Meet 25 flame/50 smoke rating for thicknesses up to 1 inch. Armacell AP/Armaflex, Rubatex Insul-Sheet 1800.

C. Jacketing material for equipment insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment insulation compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment insulation accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with Work of this Section until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PIPING SYSTEM INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems after acceptance of pressure testing.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on cold pipe insulation, including at valves and fittings. Protect vapor barrier to prevent puncture or other damage. Do not use staples. Follow recommendations of insulation manufacturer for applications indicated.

F. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

G. Insulation shall be butted against insulated pipe supports, as specified in Section 23 05 29. For hot pipes, apply 3 inches wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 inches wide vapor barrier tape or band.

H. If grooved piping system is employed where piping insulation is specified, insulate all mechanical joints as specified for pipe fittings. Maintain thermal expansion capability of grooved piping system intact.

I. Elastormeric Foam insulation:
   1. Install per manufacturer's published recommendations.
   2. Cut custom pieces from insulation sheets for use at elbows, valves, Victaulic fittings, strainers, and other irregular surfaces. Follow manufacturer's published recommendations. Obtain manufacturer's cutting templates.
   3. Seal all joints completely with proper adhesive such as Armacell 520 or Rubatex Contact Adhesive. Apply adhesive to both sides of all joints.

J. For insulated piping installed in locations exposed to weather, provide sealants, etc.for aluminum jacketing to result in watertight finished installation.

K. Provide fiberglass piping insulation for all applications unless indicated otherwise:

1. Refrigerant: Provide closed cell elastomeric foam insulation. If required insulation thickness is greater than 1.5 inch, provide fiberglass insulation.
2. Indoor Cooling Coil Condensate Drain Lines: Provide elastomeric foam insulation.

L. Minimum pipe insulation thickness:
1. Insulation thicknesses (inch / mm) for system type and pipe diameters per following table based on specified K factor. Comply with California Title 24 as a minimum, unless a more stringent requirement is specified.

Insulation Thickness Schedule						
Piping System	Runouts up to 2”	3/4” to 1”	1-1/2” to 2”	2-1/2” to 4”	5” to 6”	8” and greater
Refrigerant	1”	1”	1-1/2”	1-1/2”	1-1/2”	1-1/2”

3.3 DUCTWORK SYSTEM INSULATION

A. General: Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except at fire dampers, fire/smoke dampers, or where otherwise indicated.

F. Insulate all ductwork except for the following, unless otherwise indicated:
1. Exhaust ductwork, unless within 25 feet of fan.
2. Conditioned air supply duct exposed in conditioned area served by that duct.
3. When code prohibits.

G. Application requirements:
1. Ductwork Installed within Buildings: Insulate with minimum 1-1/2 inches thick (installed thickness 1 inch), fiberglass duct wrap insulation with vapor barrier, unless otherwise specified.

3.4 EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer’s written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

D. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

E. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable.

F. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

END OF SECTION 23 07 00

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Pipe and Fittings.
2. Specialty Valves.
3. Gas Cocks.
4. Pressure Regulators.
5. Settlement Joints.
6. Pipe Escutcheons.
7. Fire Barrier Penetration Seals.

B. This Contractor shall furnish all labor, materials, pipe supports, sheaves, hangers, tools, equipment and perform all work and services necessary for furnishing and installation of a complete, natural gas piping system. Although all Work is not specifically shown or specified, all valves, regulators, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation shall be furnished and installed as part of the Work of this Section.

1.2 PROJECT CONDITIONS

A. All natural gas piping where primary gas pressure is greater than 0.5 inches in water column shall be welded.

B. All natural gas piping installed on the roof shall be hot dip galvanized steel, threaded, and painted per direction of OWNER.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections and Section 22 05 00.
1. Product Data for the following:
   a. Underground, above ground, and roof mounted pipe, fittings and hangers.
   b. UL/FM listed gas valves.
   c. Gasket material.
   d. Pressure reducing valves. Include pressure rating, capacity, and settings of selected models.
   e. Flexible connectors. Include pressure rating, capacity, and settings of selected models.
   f. Settlement joints.
   g. Gas vault for settlement joints

B. Shop Drawings: For underground and above ground systems. Include plans, elevations, sections, details and attachments to other Work. Show different pressure zones and indicate pressure for each zone.

1. Gas Vault: Contractor shall furnish calculations, tie downs and waterproofing details for fully immersed vault for review and approval.

C. Design Calculations: In accordance with the design, loading, and material specifications, submit calculations and supporting drawings showing product geometry, placement and type of reinforcement, location of openings and other special features. Calculations shall be supplied by a California registered professional engineer.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Maintenance Data: For natural gas specialties and accessories to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Piping shall bear label, stamp or other markings of ANSI/ASME B31.2.

B. All pipe and fittings shall be manufactured in the United States.

C. Electrical Components and Devices: Listed and labeled as defined in CEC, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with the most current edition of NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installation; inspecting; testing and purging.

E. FM Standard: Provide components listed in FM's "Fire Protection Approval Guide" if specified to be FM approved.

F. IAS Standard: Provide components listed in IAS's "Directory of A. G. A. and C. G. A Certified Appliances and Accessories" if specified to be IAS listed.

G. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" if specified to be UL listed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.6 COORDINATION

A. General: Coordinate inlet locations to all gas-fired equipment with mechanical contractor and kitchen equipment contractor. Coordinate any additional valves, regulators, devices, etc. which may be required for a complete installation.

1.7 TESTING

A. General: Gas piping shall be tested and made tight in accordance with CPC and any other governing local gas codes.

B. Records:
   1. Provide record of pipe tests.
   2. Include certificate of all tests in O&M Manual.

1.8 DRAWING SCHEDULE

A. Schedules on Drawings indicate model numbers, symbols and additional information concerning products specified in this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Corrugated, Stainless-Steel Tubing Systems:
      a. Omega Flex, Inc.
      b. Titeflex Corp.
      c. Tru-Flex Metal Hose Corp.
      d. Ward Manufacturing, Inc.
   2. Appliance Connector Valves:
      a. Watts Industries, Inc.; Water Products Div.
      b. Conbraco Industries, Inc.; Apollo Div.
      c. Brass Craft Manufacturing Co.
   3. Gas Valves, NPS 2 (DN 50) and Smaller: As specified in Section 23 05 23.
   4. Plug Valves, NPS 2-1/2 (DN 65) and Larger: As specified in Section 23 05 23.
   5. Automatic Gas Valves:
      a. ASCO General Controls.
      b. Approved Equal.
   6. Appliance Pressure Regulators:
      a. Canadian Meter Co., Inc.
      b. Eaton Corp.; Controls Div.
      c. Harper Wyman Co.
      d. Maxitrol Co.
      e. SCP, Inc.

2.2 PIPING MATERIALS

A. General: The application of the following pipe and fitting material and joining methods required for natural gas piping systems are indicated in Part 3 Article “Pipe Fittings and Applications.”

B. Gas Pipe Below Ground: yellow plastic pipe, tubing and fittings conforming to ASTM D 2513, SDR 11. Pipe shall bear the stamp marked “Gas” and “ASTM D2513.”

C. Gas Pipe Above Ground (Inside Facility): Black steel pipe, ASTM A53; Type E or S, Grade B; Schedule 40, seamless, beveled ends, butt welded and/or threaded.

D. Gas Pipe Above Ground (Roof): All exposed gas piping on the roof shall be hot-dipped galvanized (zinc-coated) steel pipe, ASTM A53; GTC DN; Schedule 40, threaded fitted. Paint all exposed piping on roof as directed by OWNER.

E. Applications of pipe, tube, fitting, and joining materials is indicated in Part 3, Pipe Fittings and Applications Article.

2.3 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

A. Below Ground: Yellow plastic pipe, tubing and fittings conforming to ASTM D 2513, SDR 11. Piping system installation shall meet PG&E A-90 and A-93.1 requirements.
   1. Polypipe Pipe Fittings: ASTM D2863, socket type or ASTM D3261, butt type with dimensions matching ASTM D2513, SDR 11, polypipe pipe.

B. Above Ground (Inside Facility): Black steel pipe, ASTM A53; Type E or S, Grade B; Schedule 40, butt welded.
   1. Steel Welded Fittings: ASME B16.9 wrought steel butt-welding type or ASME B16.11, forged steel.

C. Above Ground (Roof): Hot-dipped galvanized (zinc-coated) steel pipe, ASTM A53; GTC DN; Schedule 40, threaded fitted, butt welded for gas pressures more than 0.5-inch in the water column.
   1. Hot-dipped galvanized (zinc-coated) Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
   2. Hot-dipped galvanized (zinc-coated) Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
   3. Hot-dipped galvanized (zinc-coated) Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
   4. Joint Compound and Tape: Suitable for natural gas.
   5. Gasket Material: Thickness, material, and type suitable for natural gas.

D. Transition Fittings: Type, material, and end connections to match piping being joined.

2.4 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

2.5 SPECIALTY VALVES

A. Valves, NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

C. Appliance Connector Valves: ANSI Z21.15 and IAS listed.

D. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig (13.8-kPa) minimum pressure rating.

E. Gas Valves, NPS 2 (DN 50) and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig (860-kPa) pressure rating.

1. Tamperproof Feature: Include design for locking.

F. Plug Valves, NPS 2-1/2 (DN 65) and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig (860-kPa) pressure rating.
   1. Tamperproof Feature: Include design for locking.

G. General-Duty Valves, NPS 2-1/2 (DN 65) and Larger: ASME B16.38, cast-iron body, suitable for fuel gas service, with "WOG" indicated on valve body, and 125-psig (860-kPa) pressure rating.
   1. Gate Valves: MSS SP-70, OS&Y type with solid wedge.

H. Automatic Gas Valves: ANSI Z21.21, with mechanical operator for actuation by appliance automatic shutoff device.

2.6 GAS COCKS

A. Manufacturers
   1. Apollo.
   2. Crane.
   3. Lukenbeimer.
   4. McDonald.

B. Up to and including 2 inches: Bronze, square head with wrench, threaded. Similar to Crane, Fig. 250.

C. Over 2 inches: Iron, square head with wrench, flanged. Similar to Crane, Fig. 325.

D. For appliances provides integral lever handle. Similar to Crane, Fig. 298.

2.7 SETTLEMENT JOINTS

A. General:
   1. Provide settlement joints for natural gas service as shown on the Plumbing Drawings and as listed in the Plumbing Schedule.
   2. Settlement joints shall have a total of ±18-inch movement (settlement) with carbon steel Schedule 40 weld ends. Settlement joints shall be constructed to CGA/AGA standards but not carry the CGA/AGA sticker. Settlement joints shall be manufactured by Metraflex.

2.8 PIPE ESCUTCHEONS

A. General: Provide solid (not split-hinged) pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas. All escutcheons shall be vandal proof.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide solid cast brass or sheet brass escutcheons, solid pipe escutcheons.

C. Pipe Escutcheons for Dry Areas: Provide solid sheet metal escutcheons.

D. Manufacturer: Chicago Specialty, Producers Specialty, Sanitary-Dash.

2.9 FIRE BARRIER PENETRATION SEALS

A. Provide seals for opening through fire-rated walls, floors, or ceiling used as passage for mechanical components such as piping or ductwork. Refer to details on Drawings.
   1. Piping: Provide fire stopping material as specified in Section 07 84 13.

PART 3 - EXECUTION

3.1 PREPARATION FOR BURIED PIPING

A. Grade trench bottom to provide smooth, firm, stable, and rock-free foundation throughout length of piping.

B. Remove unstable, soft and unsuitable materials at surface on which piping is to be laid and backfill with clean sand or pea gravel to indicated level.

C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped-sand backfill. Dig holes at each end of pipe joint to relieve loads and to ensure continuous bearing of pipe barrel on foundation.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in Part 3, Article Field Quality Control to determine that all equipment is turned off in affected piping section.

B. Comply with NFPA 54.

3.3 SERVICE ENTRANCE PIPING

A. Extend natural gas piping from each building and connect to fuel gas distribution for service entrance to building.
   1. Exterior natural gas distribution system piping will be provided by Civil Site Drawings.
   2. Natural gas distribution system piping, service pressure regulator, and service meter are specified in Division 33 Section Natural-Gas Distribution.

B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Comply with Section 22 05 00 for dielectric fittings.

3.4 PIPE FITTINGS AND APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Fuel Gas Piping, 0.5 psig (3.45 kPa) or Less: Use the following:

1. NPS 1/2 (DN 15) and Smaller: NPS 3/4 (DN 20) steel pipe, malleable-iron threaded fittings, and threaded joints.
2. NPS 1/2 (DN 15) and Smaller: Hard copper tube, copper fittings, and brazed joints.
   a. Option: Soft copper tube, copper fittings, and brazed joints may be used for runouts at individual appliances.
3. NPS 1/2 (DN 15) and Smaller: Tin-lined copper tube, copper fittings, and brazed joints.
4. NPS 1/2 (DN 15) and Smaller: Corrugated, stainless-steel tubing system and threaded joints.
5. NPS 3/4 and NPS 1 (DN 20 and DN 25): Steel pipe, malleable-iron threaded fittings, and threaded joints.
6. NPS 3/4 and NPS 1 (DN 20 and DN 25): Hard copper tube, copper fittings, and brazed joints.
   a. Option: Soft copper tube, copper fittings, and brazed joints may be used for runouts at individual appliances.
7. NPS 3/4 and NPS 1 (DN 20 and DN 25): Corrugated, stainless-steel tubing system and threaded joints.
8. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Steel pipe, malleable-iron threaded fittings, and threaded joints.
9. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Steel pipe, steel welding fittings, and welded joints.
10. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Steel pipe, malleable-iron threaded fittings, and threaded joints.
11. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Steel pipe, steel welding fittings, and welded joints.
12. Larger Than NPS 4 (DN 100): Steel pipe, steel welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

A. Appliance Shutoff Valves for Pressure 0.5 psig (3.45 kPa) or Less: Appliance connector valve or gas ball valves (U.L. Listed).

B. Piping Line Valves, NPS 2 (DN 50) and Smaller: Ball valve (U.L. Listed).

C. Piping Line Valves, NPS 2-1/2 (DN 65) and Larger: Plug valve.

3.6 PIPING INSTALLATION

A. Comply with Section 22 05 00 for basic piping installation requirements.

B. Locations: Except as specified below, install concealed gas piping of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
   1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
   2. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
      a. Exception: Tubing passing through partitions or walls.
   3. In Walls: Gas piping with welded joints and protective wrapping specified in Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.

4. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   a. Exception: Accessible above-ceiling space specified above.

C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.

E. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

G. Connect branch piping from top or side of horizontal piping.

H. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

I. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

J. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.

K. Install pressure gage upstream and downstream from each line pressure regulator.

L. Install flanges on valves, specialties, and equipment having NPS 2-1/2 (DN 65) and larger connections.

M. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

N. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches (100 mm) outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.7 JOINT CONSTRUCTION

A. Refer to Division 22 Section Common Work Results for Plumbing for basic piping joint construction.

B. Use materials suitable for fuel gas.
   1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F (540 deg C). Brazing alloys containing phosphorus are prohibited.

3.8 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 22 05 29 for pipe hanger and support devices.

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
   5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (16 mm).

C. Install hangers for horizontal hard copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8 (DN 10): Maximum span, 48 inches (1219 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1829 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
   4. NPS 1 (DN 25): Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).

D. Install hangers for horizontal corrugated, stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): Maximum span, 48 inches (1219 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 3/4 and NPS 1 (DN 20 and DN 25): Maximum span, 72 inches (1829 mm); minimum rod size, 3/8 inch (10 mm).
   3. Option: Support tubing from structure according to manufacturer's written instructions.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches (1800 mm) of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

E. Ground equipment.
   1. 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 ANSI/UL 486A - 486B.
   2. Do not use gas pipe as grounding electrode.

3.10 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.
   1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
   2. Comply with Section 23 05 53 for nameplates and signs.

3.11 PAINTING

A. Use materials and procedures in Division 9 Section, Painting and Coating.

B. Paint all exposed exterior piping, pressure regulators, and specialty valves, as directed by Owner's Representative.
   1. Color: Gray (Verify color with Owner's Representative).

3.12 FIELD QUALITY CONTROL

A. Inspect, test, and purge piping according to NFPA 54 and requirements of authorities having jurisdiction.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Report test results promptly and in writing to the Owner's Representative and authorities having jurisdiction.

D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

E. Verify correct pressure settings for pressure regulators.

F. Verify that specified piping tests are complete.

3.13 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 23 11 23

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Refrigerant piping used for air-conditioning applications.

1.2 REFERENCES

A. ANSI/ASHRAE 15-2016 - Safety Standard for Refrigeration Systems.

B. ANSI/ASHRAE 34-2013 - Designation and Safety Classification of Refrigerants.

C. ANSI/ASME B16.22-2013 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

D. ANSI/ASME B31.5-2016 - Refrigeration Piping and Heat Transfer Components.

E. ASTM B32-2014 - Solder Metal.

F. ASTM B280-2016 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

G. ASTM B828-2016 - Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings.

H. AWS A5.8/A5.8M-2011 - Filler Metals for Brazing and Braze Welding.

I. ASME Boilers and Pressure Vessels Code.

J. ANSI/ARI 49-2011 - Refrigerant Liquid Receivers.

K. ARI 730-2013 - Flowcapacity Rating and Application of Suctionline Filters and Filterdriers.

L. ARI 750-2007 - Thermostatic Refrigerant Expansion Valves.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include Pressure drop based on manufacturer’s test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual 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.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, Safety Code for Refrigeration Systems.

B. Comply with ASME B31.5, Refrigeration Piping and Heat Transfer Components.

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

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 misalignment in minimum 7-inch long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 degrees F.

2.2 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.
7. Maximum Operating Temperature: 275 degrees F.

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 degrees F.

C. 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.

D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 115-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 degrees F.
8. Manual operator.

E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by and NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 degrees F.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, bur are not limited to the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arkema Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-410: Difluoromethane, Pentafluoroethane.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1½ and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.

B. Suction Lines NPS 4 and Smaller MPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

C. Hot-Gas and Liquid Lines and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.

D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
1. NPS 1½ and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
2. NPS 1½ and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

G. Safety-Relief-Valve Discharge Piping:
1. NPS 1½ and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
2. NPS 1½ and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed 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 strainers if they are not an integral part of strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Install a full-sized, three-valve bypass around filter dryers.

E. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

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 buildings 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. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. 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 panels as specified in Division 8 Section “Access Doors and Frames” if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. 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.

N. 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 no apply heat near expansion-valve bulb.

O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

P. Seal penetrations through fire and smoke barriers according to Section 07 84 00, Firestopping.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

S. Seal pipe penetrations through exterior walls according to Section 07 90 00, Joint Protection for materials and methods.

T. Identify refrigerant piping and valves according to Section 23 05 53, Identification for HVAC Piping and Equipment.

3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

B. 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. Hanger, support, and anchor products are specified in Section 23 05 29, 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 long.
   2. Roller hangers and spring hangers for individual runs 20-feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20-feet 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 sizes:
   1. NPS 1/2: Maximum span, 60-inches; minimum rod size, 1/4-inch.
   2. NPS 5/8: Maximum span, 60-inches; minimum rod size, 1/4-inch.
   3. NPS 1: Maximum span, 72-inches; minimum rod size, 1/4-inch.
   4. NPS 1-1/4: Maximum span, 96-inches, minimum rod size, 3/8-inch.
   5. NPS 1-1/2: Maximum span, 96-inches, minimum rod size, 3/8-inch.
   6. NPS 2: Maximum span, 96-inches; minimum rod size, 3/8-inch.
   7. NPS 2-1/2: Maximum span, 108-inches; minimum rod size, 3/8-inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Line Test Pressure for Refrigerant R-410A:
      a. Suction Lines for Air-Conditioning Applications: 185 psig.
      b. Suction Lines for Heat-Pump Applications: 325 psig.
      c. Hot-Gas and Liquid Lines: 325 psig.
   4. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in No. 3 above.
      a. Fill system with nitrogen to the required test pressure.
      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.

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. 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.
   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 controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Verify that compressor oil level is correct.
   2. Check open compressor-motor alignment and verify lubrication for motors and bearings.

END OF SECTION 23 23 00

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SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Duct Materials.
2. Ductwork - General.
3. Round Ductwork.
4. Flexible Ductwork.
5. Plenums.
6. Kitchen Hood Exhaust Ductwork.
7. Shower Exhaust Ductwork.
8. Chemical Fume Hood Ductwork.

B. Related Work Specified in Other Sections
1. Duct smoke detectors are furnished and connected under Fire Alarm Work, and installed as Work of this Section.
2. Wiring and conduit to fire/smoke dampers is specified under Electrical Work.

1.2 REFERENCES

A. ASHRAE - Handbook Fundamentals; Duct Design.

B. ASHRAE - Handbook Equipment; Duct Construction.

C. ASTM A90/A90M- Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

D. ASTM A167-99 (R2004) - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A653/A653M- Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM B209- Aluminum and Aluminum Alloy Sheet and Plate.

G. NFPA 90A- Installation of Air Conditioning and Ventilation Systems.

H. NFPA 90B- Installation of Warm Air Heating and Air-Conditioning Systems.

I. NFPA 96- Ventilation Control and Fire Protection of Commercial Cooking Operations.

J. SMACNA - HVAC Duct Construction Standards.

K. UL 181- Factory-Made Air Ducts and Air Connectors.

1.3 DEFINITIONS

A. Duct Sizes: Outside clear dimensions.

B. Pressure Classifications:
   1. SMACNA 2-inch Standard with Seal Class A:
      a. Ductwork and plenums installed outdoors.
      b. Housing Building supply ductwork and plenums between air handling unit and points where ducts enter chases.
   2. SMACNA 1-inch Standard with Seal Class C:
      a. Other ductwork and plenums other than listed above, unless indicated otherwise.

C. Seam: Locks or weld applied longitudinally to close section of duct, e.g., longitudinal seam, spiral seam.

D. Joint: Abutting connection between duct sections for continuity of air passage, e.g., cross joint, transverse joint, coupling.

E. Reinforcement: Hardware applied to strengthen duct, e.g., girth angles, tie rods, fasteners (not connectors), etc.

F. Stiffening: Folding, bending, beading, crossbreaking or corrugating of sheets to achieve strength through shape, e.g., pocket lock secures joint and is transverse stiffener, with girth angle and/or fasteners applied (not connectors), joint or stiffener.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the OWNER Representative. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 REGULATORY REQUIREMENTS

A. Construct ductwork to California Mechanical Code..

1.6 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data:
   1. Provide make and model, gages for each duct size, material data sheets, and information for fittings.

C. Shop Drawings: CAD-generated and drawn to 1/4-inch equals 1-foot scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building to grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.

9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

D. Quality Control Submittals:
1. Coordination Drawings: reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
   a. Ceiling suspension assembly members.
   b. Other systems installed in same space as ducts.
   c. Ceiling and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
   d. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
2. Welding certificates.
3. Field quality-control test reports.

E. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for kitchen hood exhaust systems.

F. Security Details: Submit drawings to clearly identify installation details of all security-related HVAC items. Details shall be based on actual Project conditions and shall indicate means of access to dampers and damper actuators.
1. Security air outlet at wall.
2. Duct penetration of wall with security barrier.
3. Duct fire damper at wall with security barrier.
4. Duct fire/smoke damper at wall with security barrier.
5. Air outlet and fire/smoke damper at wall with security barrier.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, Structural Welding Code - Steel, for hangers and supports and AWS D9.1, Sheet Metal Welding Code, for duct joint and seam welding.

B. NFPA Compliance:
1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Spiral Round Ducts:

1. United McGill.

B. Flexible Connections:
   1. Ventfabrics, Inc.
   2. Duro Dyne.

C. Flexible Ducts:
   1. Thermaflex
   2. United McGill.
   3. Automatic Industries, Inc.

D. Spring Fasteners:
   1. Dzus.
   2. Simmons “Quick-Lock.”.

E. Duct Protective Coatings:
   1. Varni-lite Corporation of America.

F. Duct Sealants:
   1. Minnesota Mining and Manufacturing Company (3M).
   2. Benjamin Foster Company.
   3. United McGill Corporation.
   4. Hardcast Corporation Inc.
   5. Miracle Adhesive Corporation.

G. Spin-in Fittings:
   1. Modular Metals.
   2. R & J Manufacturing.

2.2 DUCT MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25-ounce per square foot for each side in conformance with ASTM A90.

C. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Mill finish. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

D. Stainless Steel Ducts: ASTM A167, Type 304 18-8. Concealed: Finish 2B or 3. Exposed: Finish 3 or 4.

E. Fasteners: Rivets, bolts, or sheet metal screws.
   1. Screws and Rivets:
      a. Same material as sheet, except as noted.
      b. On aluminum sheets, provide cadmium plated or stainless steel.
      c. Zinc or cadmium plated, permitted on galvanized sheets.
      d. Minimum Screw Size: No. 1C.
      e. Minimum Rivet Size: 4-lb.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic. Gaskets: Continuous, reinforced, inert self-conforming type. 1/8-inch thick. Width, to match angle connection.

G. Hard-Setting Joint Tape:
   1. Two-part Tape:
      a. Mineral impregnated woven fiber tape.
      b. Impregnated with activator/adhesive of polyvinyl acetate type.
   2. UL Listed:
      a. Flame Spread: 10.
      b. Smoke Contributed: 0.

H. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

I. Spring Fasteners:
   1. Oval head stud and receptacle.
   2. Screwdriver slot.
   3. Self-ejecting.
   4. Similar to Dzus.

J. Angles, tie rod and shapes for reinforcing ducts in accordance with SMACNA Duct Construction Standards, except as noted.

K. Duct Lining: Not allowed.

2.3 DUCTWORK - GENERAL

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

C. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Only where absolutely unavoidable, divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10-percent duct area, split into two ducts maintaining original duct area.

2.4 ROUND DUCTWORK

A. General:
   1. Flow low pressure.

2. Prefabricated spiral lockseam duct.
3. Prefabricated fittings.
   a. Same manufacturer as duct and as detailed.
   b. Continuity welded seams.
   c. Die-stamped elbows for 8-inches or smaller.
   d. Mitered elbows larger than 8-inches.
      1) 2 Gores: less than 35 degrees.
      2) 3 Gores: 36 degrees through 71 degrees.
      3) 5 Gores: over 71 degrees.
4. Not Acceptable:
   a. Corrugated or flexible metal duct.
   b. Shop fabricated circular duct, except above maximum factory-fabricated size.
   c. Fiberglass ductwork.
5. Provide ducts with gauges meeting CMC and NFPA 90A, whichever is more strict.

B. Round Duct and Fittings:
1. Duct Construction:

Duct Diameter (in)	Spiral Duct Gage	Fitting Gage
3-14	26	20
15-26	24	20
27-36	22	20
37-50	20	18
51-60	18	16

2. Similar to United Sheet Metal “Uniseal” with “Uniform” fittings.

C. Accessories: Factory fabricated.
1. Couplings.
2. Volume dampers.
3. Bellmouth fittings.
4. End caps.
5. Fire damper access section.
6. Angle rings.
7. Insulation Ends: Connections of double to single wall ducts.

2.5 FLEXIBLE DUCTS

A. General:
1. Use only where specified or indicated.
2. UL 181, Class I Air Duct.
3. Labeled for compliance with CMC.

B. Low Pressure:
1. Insulated Flexible Duct:
   a. Minimum working pressure 1.5-inches w.g.
   b. Nominal 1-inch insulation with vapor barrier.
   c. Maximum thermal conductivity 0.27-Btuh/sq. ft. degrees f/inch at 75 degrees F.
2. Use At Following Locations:
   a. Connection to ceiling air outlets in non-secure areas.

b. As indicated.

2.6 SHOWER EXHAUST DUCTWORK

A. Construct of aluminum or stainless steel with welded joints.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Construct with gauges, joints, bracing, reinforcing, and other details per CMC, ASHRAE, SMACNA, or NFPA standard unless specified otherwise.
   a. Comply with most stringent.
   b. Provide ducts with NFPA 90A gauges when traversing smoke zones.
2. Install ductwork of sizes, runs and connections as shown on the drawings.
3. Verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Dimensions shown are net free areas. Make allowances for beams, pipes or other obstructions in building construction and for work of other trades. Check plans showing work of other trades and consult with OWNER Representative in the event of any interference.
4. Fabricate ductwork in workmanlike manner with airtight joints, presenting smooth surfaces on inside, neatly finished on outside, construct with curves, bends, turning vanes to aid in easy flow of air. Make internal ends of slip joints in direction of airflow.
5. Construct, brace and support ducts and air plenums to prevent sagging and to minimize vibration when fans are operating.
6. Maintain rectangular cross section of ductwork unless otherwise shown.
7. Blow out all dirt and foreign matter from ductwork, and clean diffusers, registers and grilles before fans are started.
8. Unless otherwise noted, construct ductwork as specified for low pressure ductwork.
9. All angle irons required for ductwork construction and support shall be galvanized.
10. Construct of galvanized sheet metal, except where otherwise indicated.
11. Diagonally crossbrace all panels on metal rectangular ducts over 18-inches in either direction. Beading for reinforcing is acceptable.
12. Duct dimensions indicated are net, outside, clear dimensions.
13. Alter duct sizes on basis of equal friction where required to facilitate installation.
14. Penetrations of ducts are forbidden without approval from the OWNER Representative. Provide airtight rubber grommets at unavoidable penetrations of hanger rods.
15. At exposed duct penetrations of walls, floors and ceilings, provide sheet metal angle type escutcheons.
16. At supply diffusers, grilles and/or registers extend branch duct 1-foot beyond air outlet.
17. Install exposed ducts to maintain not less than 7-feet head clearance, unless indicated otherwise.
18. Tapers: Pitch sides of duct in “diverging” or “converging” airflow maximum of 1 to 4 taper.
19. Duct Opening:
   a. Provide openings where required to accommodate thermometers, smoke detectors, controllers, etc. Insert through airtight rubber grommets.
   b. Provide Pitot tube openings where required for testing of systems:

1) Complete with metal cap with spring device or screw to ensure against air leakage.
2) For Pitot tube test install test holes.

c. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
d. At fire dampers and fire/smoke dampers, allow adequate length of duct to install duct access door.

20. Tapers:
    a. Pitch sides of duct in a "diverging" airflow maximum of 20 degrees.
    b. Pitch sides of duct in a "converging" airflow maximum of 30 degrees.
    c. Design elbows for minimum friction with inside radius not less than width of duct. Use square elbows with hollow double radius type duct turns where radius is less than duct width. Attach duct turns to duct securely with spot weld, screws, or rivets. Friction type attachment not acceptable.
21. Branch Duct Connections: Make branch duct connections to other ducts or plenums in such a manner that it provides a smooth airflow with minimum turbulence and minimum air pressure drops at the connections. Use parallel flow connections or 45-degree clinch collars or bell mouth, and provide air volume control dampers. Straight tap connections are not acceptable unless specifically shown.
22. Flashing Ducts Through Roof: Install flashing to cover top and sides of curb and fit closely around duct. Cover tope edge of base flashing with collar soldered to duct and turned down over base flashing. Fabricate flashing from 24-gauge galvanized steel. See HVAC details on plans for further information.
23. Test Holes: Drill instrument test holes into ductwork for Pitot tube tests. Install hole covers attached to ductwork by sheet metal screws. Locate test holes at intake and discharge from each air handling unit and as shown.
24. Remove all debris and oily residue from ductwork and plenums after manufacturing and prior to installation.
25. Cover and seal all openings in ductwork during transportation and storage; remove just prior to installation. Prevent dirt and moisture from entering ductwork after installation. Cover and seal openings at the end of each work day.

B. Elbows and Transitions:
1. Construct radius elbows with inside radius not less than duct width.
2. Use square turns in rectangular ductwork, unless indicated otherwise, at following locations:
    a. Immediately upstream from supply air outlets.
    b. Where required to facilitate installation.
3. Provide turning vanes in miter elbows in round and rectangular ducts.
4. Where indicated, provide turning vanes of special size and shape.
5. Tow-way Splits:
    a. Supply, return and exhaust.
    b. Two Elbows:
        1) Proportionally sized per SMACNA Duct Standards.
        2) Radius or square.
    c. Single fitting acceptable with turning vanes. Duct opening sized as above.

C. Rectangular Duct Joints:
1. Standing seams, except where flush drive slip seam called for.
2. Use flush, drive-slip, for:
    a. Exposed ducts.

b. Where required for clearance.
c. In ducts no wider than 60-inches.

D. Joint Sealing:
1. Seal transverse and longitudinal joints of sheet metal ducts, including angle iron connections, by one of following methods:
a. Six ounce canvas strip, six inches wide. Adhere with lagging adhesive.
b. Applications as recommended by manufacturer.
2. Seal punched holes and corner cracks.
3. After installation and balancing reseal joints found to be leaking.

E. Ducts Outdoors:
1. Make ducts watertight.
2. Use double corner or Pittsburgh seams for longitudinal seams.
3. Use capped flanges for transverse joints.
4. "Ductmate" system joints may be used in lieu of capped flanges for transverse joints.
a. In ducts no wider than 60-inches.
b. Installation as recommended by manufacturer.
c. Ductmate angle to be fastened to the duct section with spot welds.
d. Install cleat full length in one-piece on the top of the joint to prevent water from collection on the gasket.
5. Construct as follows to assure water runoff:
a. Arrange flanges to not act as dams.
b. Longitudinal seams at top of duct.
c. Slope entire top of duct down toward side.
d. Vertical struts within duct to bow top panels of duct into convex shape.
e. Mastic within sheet metal joints.

F. Aluminum Ductwork:
1. Aluminum Sheets: One gauge heavier than galvanized steel as tabulated.
2. Joints and seams made watertight by soldering, aluminum welding.
3. Grilles on aluminum ductwork: aluminum.
4. Separate aluminum ducts, casings, plenums, housing and louvers from direct contact with concrete by resilient gasketing or caulking compound.
5. Pitch down to 1/8-inch to 1/4-inch per foot toward air intake opening.

G. Stainless Steel Ductwork Material Thickness and Construction Details: As specified for low pressure ductwork except as noted otherwise. Pitch down to 1/8-inch to 1/4-inch per foot toward air intake opening.

H. When exposed ducts are located within ten feet of the floor or ground in an inmate accessible area:
1. Ducts shall be welded rectangular ducts; minimum 14-gauge. Sections shall be welded or screwed together with security type screws; slip joints are not allowed.
2. Mount tight against ceiling or deck above with supports made from minimum 14-gauge material. Fasten mounting with security type screws.
3. Cover cracks exceeding 1/32-inch wide between duct and ceiling or deck with 1/4-inch thick steel angle, minimum 1 by 1-inch size, spot welded to the duct and bolted to the ceiling or deck with security type screws.

I. Security Grilles at Wall Openings and Duct Penetrations of Secure Walls, Partitions, Floors and Roofs:
   1. Security Grille: At openings exceeding 5-inches in any dimension, and duct penetrations in perimeter walls, floors, and ceiling/roof of secure rooms and areas, fit to the opening an assembly of round steel bars welded to a perimeter steel frame; install on the side away from the opening if possible. Seal ductwork to prevent air leakage.
   2. Comply with details on Mechanical Drawings.

3.2 ROUND DUCTWORK

A. Fittings: Factory fabricated with radius of elbows and angles minimum of 1½-times diameter of duct. Where tee fittings of conical type change in shape from round to rectangular, utilize a transformation joint with a taper ratio of 1 to 7.

B. Joints Between Ducts:
   1. Made with beaded sleeve joints as scheduled.
   2. Duct sealer applied to male end.
   3. Mechanically fastened with sheet metal screws or pop rivets.
   4. Over joint and screw or rivet heads, apply coating of duct sealer.
   5. Cover entire joint with duct tape.

C. Joints, Duct and Fitting:
   1. Slip projecting collar of fittings into duct. Insertion length 2-inches minimum.
   2. Apply duct sealer. Seal and tape as specified above.
   3. Mechanically fasten per following Fastening Schedule:

No. of Rivets	Diameter	Slip Joint
4	8-inches	3/4-inch
6	9 to 16-inches	1-inch
7	17-inches and larger	1 1/4-inch

D. Junctions Between Ducts: Branch takeoff conical 90 degrees.

E. Horizontal Supports:
   1. One or two-piece clamp band strap.
   2. Minimum: One per section.
   3. Support fittings to prevent sagging.

F. Vertical Support: One of the following:
   1. Clamp bands with extended ends supported by floor.
   2. Clamp bands with knee bracing.
   3. Pedestal at base of vertical.

3.3 FLEXIBLE DUCTWORK

A. Provide insulated flexible ducts continuous, single pieces not over seven feet in length, adequately supported, and have a minimum inside bending radius of two-thirds the internal diameter, but not installed with a radius of bend less than two duct diameters.

B. Provide 4-inches wide sheet metal protection saddles under ductwork at each hanger.

C. Where flexible ducts join other ductwork and air terminals, apply duct sealer to outside surface of collar. Secure duct to collar with sheet metal screws and clamps, and seal joint with three wraps of pressure sensitive vapor seal adhesive tape.

D. Use only on supply air application.
   1. At non-security ceiling air outlets.

E. Install flexible ducts in as straight a manner as possible. Cut ducts to lengths required, maximum 7-feet, rather than create bends to take up excess lengths. Terminate flexible duct perpendicular to the connection.

F. Connect flexible ducts to metal ducts with draw bands.

G. Use crimp joints with or without bead for joining round duct sizes 8-inch and smaller with crimp in direction of air flow.

H. Use double nuts and lock washers on threaded rod supports.

3.4 SHOWER EXHAUST DUCTWORK

A. Slope duct 1/4-inch per foot (2-percent) down toward shower exhaust inlets.

3.5 DUCT HANGERS AND SUPPORTS

A. General:
   1. Attachment to structure, as specified in Section 23 05 09 - Hangers and Supports for HVAC Piping and Equipment.
   2. Seismic restraints shall be as specified in Section 23 05 08 - Vibration Isolation and Seismic Control.

B. Horizontal Duct Supports:
   1. Support horizontal ducts with hangers of size and spacing as indicated in pertinent SMACNA HVAC Duct Construction Standards.
   2. Install hangers at each change in direction of duct.
   3. Strap Hangers:
      a. Extend strap down both sides of ducts.
      b. Turn under bottom one inch minimum.
      c. Metal screw hangers to bottom of duct, upper and lower sides of ducts, and not more than 12-inches on center.
   4. Angle Hangers:
      a. Provide angle hangers formed by extended vertical bracing angles.
      b. Or by rods connecting to bottom angles if size or bracing angles conform to hanger schedule.
   5. Support horizontal ducts on the roof with supports of size and spacing as indicated on the drawings.
   6. Vertical Duct Supports: Support vertical ducts at every floor.
      a. Use angles or channels riveted to ducts.
      b. Set angles or channels on floor slab or structural steel members placed in opening, unless otherwise noted.

3.6 MISCELLANEOUS INSTALLATIONS

A. Install following equipment and materials in accordance with manufacturers printed instructions.
   1. Filters.

B. Duct Drains:
   1. At low points for moisture collection.
   2. 1 inch drain, galvanized steel.
   3. S-trap (or P-trap) for water seal. Minimum depth of trap 1¼ times maximum static pressure differential in duct section.
   4. Run drain to nearest plumbing drain. Terminate with one inch minimum air gap.
   5. Provide tee connection in drain.
      a. Between duct and trap.
      b. Connection from trap primer under Section 22 11 16 - Domestic Water Piping.

3.7 SLEEVES

A. Sleeves are specified in Section 23 05 00 - Common Work Results for HVAC.

3.8 LEAKAGE

A. General:
   1. Leakage of ductwork and plenums shall not exceed 3-percent of design cfm. The 3-percent leakage limit applies to each duct system as a whole.
   2. Leakage shall be determined by summation of all supply outlet cfm's on any one system subtracted from the total cfm developed by the unit serving that system.
   3. Balancer to inform OWNER Representative of any system that exceeds the 3-percent leakage allowance.
   4. Contractor to inspect the systems that exceed the 3-percent leakage allowance and reseal leaking ductwork at no additional cost to the owner until the leakage rate is within the 3-percent allowance.

3.9 DUCT CLEANING

A. Force air at high velocity through duct to remove accumulated dust.

B. Clean half system at time.

C. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. When closures are removed, avoid spilling dust in room.

D. Insulation inside the duct shall not be used on any HVAC systems.

3.10 FIRE DAMPERS

A. Demonstrate ability to reset fire dampers.

3.11 FIRE/SMOKE DAMPERS AND SMOKE DAMPERS

A. Demonstrate ability to achieve access to actuator and to visibly see damper blades.

END OF SECTION 23 31 00

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Volume control dampers.
2. Backdraft dampers.
3. Air turning devices.
4. Flexible duct connections.
5. Duct access doors.

1.2 REFERENCES

A. ASHRAE - Handbook, Fundamentals, Duct Design.

B. ASHRAE - Handbook, Equipment, Duct Construction.

C. NFPA 90A-2015 - Installation of Air Conditioning and Ventilating Systems.

D. SMACNA - HVAC Duct Construction Standards.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: For the Following:
1. Backdraft dampers.
2. Volume dampers.
3. Turning vanes.
4. Flexible connectors.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Special fittings.
2. Manual-volume damper installations.
3. Wiring Diagrams: Power, signal and control wiring.

D. Quality Control Submittals.
1. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, Installation of Air Conditioning and Ventilating Systems, and NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

1.5 MAINTENANCE

A. Extra Materials
1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
a. Fusible Links: Furnish quantity equal to 10-percent of amount installed.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Multiblade Volume Dampers:
1. Ruskin Manufacturing Company.
2. Air Balance Inc.
3. American Warming and Ventilating Inc.

B. Backdraft Dampers:
1. Air Balance, Inc.
2. American Warming and Ventilating Inc.
3. Ruskin Manufacturing Company.

C. Damper Hardware:
1. Ventfabrics, Inc.
2. Duro Dyne Corporation.
3. Young Regulator Company.

D. Acceptable Manufacturers - Air Turning Devices
1. Titus.
2. Kruger.
3. Price.

E. Acceptable Manufacturers - Flexible Duct Connections
1. Vent Fabrics Inc. Ventglas or Ventlon.
2. Duro Dyne Corporation; Super Metal Fab DDFDC-483.

2.2 VOLUME CONTROL DAMPERS.

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24-inches size in either direction, and two gages heavier for sizes over 24-inches.

C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum ¼-inch diameter rod in self aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 12 x 48-inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 by 72-inch (300 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12-inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30-inches (750 mm) provide regulator at both ends.

H. Single Blade Dampers:
   1. Galvanized Steel Ductwork: 16-gauge galvanized steel, except as noted.
   2. Low Pressure Systems: SMACNA HVAC Duct Construction Standards, except as noted.
      a. Bearing at one end of damper rod: Similar to Ventlok No. 60 or Ruskin.
      b. Accessible quadrant at other end of damper rod:
         1) With lever and lockscrew, similar to Ventlok No. 635. or Ruskin.
         2) Insulated Ducts: Quadrants mounted on bracket to clear insulation; similar to Ventlok Nos. 637, 638, or 639. Selection based on insulation thickness.
      c. For Inaccessible Dampers in Ceiling Spaces: Provide metered gear assembly with concealed ceiling regulator at other end of damper rod.
         1) With end bearing at the other end of damper rod, similar to Ventlock No. 607.
         2) With metered gears, similar to Ventlock No. 680 or Ruskin.
         3) With concealed damper regulator, similar to Ventlock No. 677 or Ruskin. One with 2-5/8-inch diameter paintable coverplate provided with an additional set of security screws.
         4) Required interconnecting hardware and set of regulator wrenches.
      d. Self-locking Splitter Damper Assembly with Accessible Quadrant: With a damper blade bracket, a double lead threaded rod, a universal joint, a lever and lockscrew, similar to Ventlock No. 690 or Ruskin.
      e. Abbreviated Self-locking Splitter Damper Assembly for Inaccessible Ceiling:
         1) With damper blade bracket, a double lead threaded rod and an extended shaft universal joint, similar to Ventlock No. 691 or Ruskin.
         2) Provide required hardware as specified under For Inaccessible Damper above.

2.3 BACKDRAFT DAMPERS

A. Description:
   1. Extruded aluminum construction.
   2. Vinyl blade edge seals.
   3. Blade ends overlapping frame.
   4. Similar to Air Balance Inc., Series 700 or Ruskin.

2.4 AIR TURNING DEVICES

A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps; Model TV manufactured by Titus.

B. Vane length not to exceed 36-inches. Provide separate equal size sections for greater lengths.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. With metal collar frames at each end.

C. 2-inch slack in fabric.

D. Install to allow minimum movement of 1-inch.

E. Length Of Fabric Connections
1. Minimum: 4-inches.
2. Maximum: 10-inches.

F. Coated Glass Fabric:
1. Indoors - Neoprene.
2. Outdoors - Hypalon, weather-resistant.
3. Flame Spread Rating: 25.
4. Smoke Development Rating: 50.
5. 30-oz. per sq. yd.
6. Sewed and cemented seams.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions. Manufacturers' installation instructions shall be made available to the OWNER Representative and inspecting authorities.

B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems at the following locations:
1. In all duct splits and branches of supply, return and exhaust systems.
2. In duct serving single outlets.
3. At open return duct above ceilings.
4. At duct splits above 36-inches deep.
5. In duct connected to common plenum.
6. Where shown on drawings.
7. Install balancing dampers at the split or branch take-off.
8. Dampers at air outlets and inlets cannot be used in lieu of balancing dampers.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Ceiling Exhaust Fans.
   2. Accessories.

1.2 REFERENCES

A. AMCA 99 - Standards Handbook.

B. ANSI/AMCA 301-2016 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

C. SMACNA - Low Pressure Duct Construction Standard.

1.3 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data
   1. Submit information including air flow capacities, static pressures, rpm, sound levels at design operating point. Provide fan curve clearly showing plotted design point.

C. Shop Drawings
   1. Submit full set of drawings showing a minimum of three views with all dimensions clearly shown, including duct connections.

D. Quality Control Submittals
   1. Provide factory test reports with each submittal.
   2. Manufacturer’s Installation Instructions.

E. Closeout Submittals
   1. Operation and Maintenance data include instructions for lubrication, motor and driven replacement, spare parts list, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.6 SYSTEM START-UP

A. Refer to Sections 23 05 00 and 23 05 93.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Loren Cook Company.

B. Penn Ventilator.

C. Greenheck.

2.2 CEILING EXHAUST FANS

A. Ceiling mounted, direct drive centrifugal type, steel housing, Units over 100-cfm shall include 1/2-inch acoustical insulation.

B. Integral ceiling grille constructed of non-yellowing high-strength polymer or high impact polystyrene. Grilles for larger sizes shall be aluminum.

C. Duct collar shall be constructed of steel and shall accept a minimum 6-inch duct size. Collar shall include integral backdraft damper.

D. Motor shall be mounted on vibration isolators. Disconnect shall be internal plug-in type.

E. Fan wheel shall be forward-curved centrifugal type, statically and dynamically balanced.

2.3 ACCESSORIES

A. Consult notes in equipment schedules for exact options to include with fans.

B. Dampers: Backdraft damper steel construction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

C. Install fans as specified, with resilient mountings and flexible electrical leads. Refer to Section 23 05 48.

D. Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Provide backdraft dampers on discharge of exhaust fans and as indicated.

F. Ceiling Fans: Provide adjustable mounting brackets to allow for ceiling thickness.

3.2 DEMONSTRATION

A. Instruct OWNER personnel under provisions of Division 1.

B. Demonstrate system and instruct OWNER personnel in operation, repair, and maintenance of the work of this section.

END OF SECTION 23 34 00

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SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Ceiling Diffusers.
   2. Grilles and Registers.

1.2 REFERENCES

A. ADC 1062: LCM-83 - Laboratory Certification Manual.

B. ADC 1062: GRD-84 - Test Code for Grilles, Registers, and Diffusers.

C. ANSI/AMCA 500 - Laboratory Methods for Testing Louvers and Dampers for Rating.

D. ANSI/ASHRAE 70 - 2011 - Method of Testing for Rating the Performance of Air Outlets and Air Inlets.

E. SMACNA - HVAC Duct Construction Standard.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawing to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer’s standard sizes to verify color selected.

1.4 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate performance of louvers in accordance with:
   1. AMCA 500.

C. Acoustical Criteria:
   1. Air Distribution System Equipment: Maximum permissible sound-power levels in octave bands of airborne transmissions through combination of grilles, registers and diffusers when operated in installed condition per plans and specifications:

D. Maximum PWL re 10 to the minus 12 Watts

Octave Bands	NC-30	NC-35	NC-40	NC-45	NC-50
1	60	62	66	68	7
2	53	56	63	66	68
3	45	49	54	58	62
4	41	46	51	56	61
5	38	43	48	53	58
6	37	42	47	52	57
7	36	41	46	51	56
8	37	42	47	52	57

E. Except as noted, maximum permissible NC levels shall be as follows:
   1. NC-30: Private offices, conference rooms.
   2. NC-35: Classrooms, libraries, small offices.
   3. NC-40: Open office areas, visiting areas.
   4. NC-45: Dining areas, waiting areas, corridors.
   5. NC-50: Shops, kitchens, toilets, storage rooms.

1.5 REGULATORY REQUIREMENTS

A. Conform to California Mechanical Code.

1.6 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product data, for each product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

E. Manufacturer's Installation Instructions.

PART 2 PRODUCTS

2.1 AIR OUTLETS AND INLETS

A. Manufacturers
   1. Titus.
   2. Price.

B. General:
   1. Manufacturer shall examine application of each outlet and guarantee that each will provide comfort space conditions without drafts at noted capacity.
   2. Noise level at noted capacities: Not to exceed criteria specified in Part 1.
   3. Suitable for operation at 10-percent excess and 25-percent less than noted capacity.
   4. Ceiling diffusers and registers shall be supplied with volume damper adjustable from face except as noted. May be omitted when a single outlet is installed on branch with volume damper.
   5. Finish matching color sample as selected by the OWNER Representative.
      a. Other special materials and finishes as indicated in schedule on drawings.
      b. Other outlets, standard finish for field painting.
   6. Provide gaskets at supply outlet flanges.

2.2 CEILING DIFFUSERS

A. Supply Air Diffusers: With air-equalizing deflectors.

B. Diffusers In Same Room: Same size and type, except as otherwise indicated.

C. Diffuser with removable core, installed in plaster: Supply plaster frames for setting under other sections.

D. Diffusers suitable for ceiling construction in which installed.

E. Provide blanking for proper coverage and blow without producing objectionable noise or air motion at occupied level. Blank-Offs: Sheet metal panels with black color exactly matching color of other exposed elements within air outlets and ceiling slots.

F. Drop collar as indicated.

G. Outside may be steel or aluminum unless indicated otherwise.

H. Air outlets at showers, kitchen, and other wet locations shall be aluminum.

I. Types:
   1. Type CD-1: Square modular core face. Frame style to match ceiling in which installed. Similar to Titus Model MCD.

2.3 GRILLES AND REGISTERS

A. Grilles:
   1. Type R-1: Eggcrate 1/2”x1/2”x1/2” grid. Frame style to match ceiling in which installed. With backplate with collar for ducted applications. Similar to Titus Model 50F.
   2. Types FR-1: Floor type grille with fixed parallel blades. Frame style to match surface in which installed. Blade spacing and blade angle as scheduled on drawings. Heavy Duty Steel construction. Similar to Titus Model 30RS.

B. Grilles:
   1. Material: Steel
   2. Finish: Baked enamel, white, Baked enamel, color selected by the OWNER Representative where called out by drawings.
   3. Face Blade Arrangement: Adjustable horizontal. Spaced 3/4-inches apart.
   4. Rear Blade Arrangement: Adjustable horizontal. Spaced 3/4-inches apart.
   5. Frame: 1-inch wide.
   6. Mounting Frame: See air distribution schedule.
   7. Mounting: Countersunk screw.
   8. Damper Type: Adjustable opposed-blade assembly.

C. Refer to Air Outlet Schedule on drawings for additional requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers’ instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Section 09 90 00.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Return and Exhaust Registers: Install with blades oriented to prevent sight through outlets.

F. Transfer Grilles:
   1. Wall Installations: Provide two grilles.
      a. One on each side of wall.
      b. Connecting sheet metal collar.
   2. Transfer Ducts: Two grilles, one at each end of duct.

G. Ceiling Diffusers:
   1. Attach removable cores with screws to diffuser body.
   2. Touch up paint screw heads with matching color supplied by diffuser manufacturer.

H. Refer to reflected ceiling plans for exact location of ceiling air outlets.

I. Install inclined blade return and exhaust grilles and registers so that blades obstruct vision by inclining blades as follows:
   1. Ceiling Outlets: Incline toward nearest wall.

2. Wall Outlets Near Ceiling: Incline toward ceiling.
3. Wall Outlets Near Floor: Incline toward floor.

J. On grilles utilizing a plenum box, provide box fabricated of 0.034-inch/22-gauge (0.864-mm) thick, galvanized steel with internal surface internally lined with minimum ½-inch (12-mm) thick duct liner as specified in this Section.

K. Blank-Offs: Where blank-offs are indicated for un-used portions of air outlets or ceiling slots, provide sheet metal panels with black color exactly matching color of other exposed elements within air outlets and ceiling slots.

L. Seal voids between security air outlets and adjacent surfaces with pick-resistant sealant as specified in Section 07 92 00.

M. Provide stainless steel air outlets in shower areas, kitchen, and other wet areas.

END OF SECTION 23 37 13

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SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Indoor Units.
2. Outdoor Units.
3. Operating Controls.
4. Refrigerant Components.

1.2 REFERENCES

A. ANSI/ASHRAE 15-2016 - Safety Standard for Refrigeration Systems.

B. ANSI/ARI 210/240-2012 - Unitary Air-Conditioning and Air-Source Heat Pump.

C. ARI 300-2015 - Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment.

1.3 SYSTEM DESCRIPTION

A. Split type air cooled air conditioning units / heat pumps for process cooling, electric refrigeration system, temperature controls, filters, DX fan coil unit, outdoor unit, compressors, and related accessories.

1.4 SUBMITTALS

A. Product Data
1. Indicate capacity, options, weights, connections for water, drain, and electrical.

B. Shop Drawings
1. Indicate equipment dimensions including dimensions of all options.

C. Quality Control Submittals
1. Manufacturer’s Instructions: Submit manufacturer’s installation instructions.
2. Field Reports: Indicate results of field testing and adjusting.

D. Closeout Submittals
1. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum three years documented experience.
2. Installer: Company specializing in applying the work of this Section with minimum three years documented experience; approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship and store in factory packing cases. Do not remove packing cases prior to installation.

B. Provide temporary covers after installation. Remove temporary covers prior to final inspection.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mitsubishi.

B. Daiken.

C. LG.

2.2 INDOOR UNITS

A. General: Consists of fan and coil section with factory installed DX coil, filter and front access.

B. High-wall type or ceiling-suspended type as scheduled.

C. Zinc coated bonderized steel with baked enamel paint, or high-impact polystyrene.

D. Fully insulated.

E. Integral controller.

F. Remote wall-mounted room temperature sensor.

G. Cleanable filters.

H. Coil: Copper tubes and aluminum fins, mechanically bonded.

I. Drip pan under coil with drain attachment.

J. Condensate Pump: Provide for units as indicated in plumbing equipment schedule. Level sensor on condensate pan shall stop cooling operation in case of pump malfunction. Provide with check valve at pump discharge.

2.3 OUTDOOR UNITS

A. General: Consists of compressor, condenser, accumulator, and controls.

B. Cabinet: Galvanized steel with enamel or baked-on powder coating.

C. Compressor: Hermetically sealed, externally isolated.

D. Condenser: Copper tube, aluminum fins; totally enclosed fan motor.

E. Accessories:
1. Short-cycle protection prevents restart of compressor for 5 minutes after shut off.
2. Time-delay relay allows brief operation of indoor unit evaporator fan after compressor has shut off.
3. Low ambient operation to 0 degrees F.

2.4 OPERATING CONTROLS

A. Electric solid state microprocessor based room controller. Provide all accessory control components necessary for a BMS interface.

B. Room thermostat shall incorporate:
1. Automatic switching from heating to cooling;
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set-up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from one hour to 31 days.
5. Short cycle protection.

C. Room thermostat display shall include:
1. Time of day.
2. Actual room temperature.
3. Programmed temperature.
4. Programmed time.
5. Duration of timed override.
6. Fan Speed.
7. System mode indication: heating, cooling, auto, off, fan auto, fan on.
8. Stage (heating or cooling) operation.

2.5 REFRIGERANT COMPONENTS

A. Full Charge of Refrigerant.

B. Service valves with service gage connection ports.

C. Indoor Unit: liquid and suction lines. See Section 23 23 00.
1. Flared connections.

D. Outdoor Unit: liquid and suction lines. See Section 23 23 00.
1. Flared connections.

E. Accumulator.

F. High Pressure Switch.

G. Thermal Expansion Valve.

H. Field Installed Accessories:
1. Coordinate with Equipment Manufacturer.

I. Refrigerant piping shall be one of the following:
1. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
a. Fittings: ASME B16.22 wrought copper.

b. Joints: ASTM B32, solder Grade 95TA.

2. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
   a. Fittings: ASME B16.26 cast copper.
   b. Joints: Flared.

2.6 SYSTEM DESCRIPTION:

A. The heat pump air conditioning system shall be a Mitsubishi Electric PUZ Series variable capacity mini-split type or equal.

B. The system shall consist of a combination of a ceiling cassette and wall mounted units with a remote controller.

C. Indoor unit model numbers shall be PLA and PKA.

D. Outdoor unit model numbers may be PUZ.

2.7 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.

C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A dry air holding charge shall be provided in the indoor section.

F. System efficiency shall meet or exceed 15 SEER when part of a 1:1 (indoor/outdoor) system.

G. Delivery, Storage and Handling
   a. Unit shall be stored and handled according to the manufacturer's recommendations.
   b. The wireless or wired controller shall be shipped separately from the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

2.8 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have a warranty of seven (7) years from the same date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

B. Manufacturer shall have over 30 years of continuous experience in the U.S. market.

2.9 PERFORMANCE AND OPERATING RANGE

A. Each system shall perform in accordance with the ratings shown in the table below.

B. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 23.9°C WB) for the outdoor unit at rated frequency: A09-35Hz, A12-51Hz.

C. Heating performance shall be based on 70ºF DB, 60 ºF WB (21.1ºC DB, 15.6ºC WB) for the indoor unit and 47 º F DB, 43º F WB (8.3 º C DB, 6.1º C WB) for the outdoor unit at rated frequency: A09-43Hz, A12-54Hz.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
   1. Install outdoor condensing unit on supports per Detail in drawings.

B. Coordinate the installation of units with architectural, structural, mechanical and electrical work.

C. Refrigerant Piping:
   1. Connect indoor and outdoor units with refrigerant piping, sized and installed according to manufacturer's recommendations.
   2. Ream pipe and tube ends. Remove burrs. Remove scale and dirt on inside and outside before assembly,
   3. Route piping in orderly manner, parallel to building structure, and maintain gradient.
   4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   5. Test system for leaks.
   6. Fully charge completed system with refrigerant after testing.

D. Condensate Drain Piping:
   1. Connect to unit drain connections.
   2. Provide traps with water seal depth 1-inch greater than for static pressure.
   3. Type M copper tubing and wrought copper fittings.
   4. Coordinate location with ducts, pipes and other building features.
   5. Submit layout of proposed routing for exposed piping for approval by the Owner's Representative.

E. Insulate piping according to Section 23 07 13.

3.2 TESTING AND BALANCING

A. Perform field inspection, adjusting, balancing, and testing. Refer to and coordinate adjusting, balancing and operational test with Sections 23 05 93.

B. In the presence of the OWNER Representative, provide an operational test to demonstrate proper operation and adequate capacity at completion of balancing and adjusting.

C. Provide repair service for one year after date of Acceptance. Provide service within 24 hours of request, including holidays and weekends.

3.3 DEMONSTRATION AND PERSONNEL INSTRUCTION

A. Instruct OWNER personnel under provisions of Division 1 and Section 23 05 00.

B. Demonstrate system and instruct OWNER personnel in operation, repair, and maintenance of the work of this section.

END OF SECTION 23 81 26

SECTION 23 81 49 - PACKAGED THROUGH-THE-WALL HEAT PUMP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Packaged Through the Wall Air Conditioning Units.
2. Packaged Through the Wall Heat Pump Units.
3. Wall Sleeves and Louvers.
4. Controls.

1.2 REFERENCES

A. AHRI 210/240-2017 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. ANSI/AHRI 300-2015 - Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data:
1. Indicate model numbers, capacities, electrical loads and weights.

C. Shop Drawings:
1. Indicate all dimensions, water, drain, and electrical rough-in connections, and all dimensions for unit and accessories.

D. Quality Control Submittals:
1. Manufacturer’s installation instructions.
2. Field Reports: Indicate results of field testing and adjusting.

E. Closeout Submittals:
1. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Friedrich Air Conditioning Co.

B. Carrier

C. Trane

D. Or approved equal

2.2 PACKAGED THROUGH THE WALL AIR CONDITIONING UNITS

A. Packaged, self-contained, through-the-wall air cooled terminal air conditioning/heat pump units (see drawings), with wall sleeve, room cabinet, electric refrigeration system, electric heating, outside air louvers, built-in temperature controls and filters.

B. Cabinet
1. Cabinet: Wall mounted or Floor mounted (see drawings) of 18-gauge galvanized steel with baked enamel finish, removable front panel with concealed latches.
2. Discharge Grill and Access Door: Removable indoor discharge grills, allowing 4-way discharge air pattern, with hinged door in top of cabinet for access to controls.

C. Chassis.
1. Refrigeration System:
   a. Direct expansion cooling coil, seamless copper, aluminum fins.
   b. Hermetically sealed compressor with internal spring isolation, external isolation, permanent split capacitor motor and overload protection.
   c. Accumulator.
   d. Condenser coil and fan.
   e. Coaxial tube in tube condenser with water regulating valve.
   f. Capillary restrictor and constant pressure expansion valve.
   g. Reversing valve (Heat pump only).
   h. Fully charged with refrigerant.
   i. Factory test to 600 psig.
2. Air System: Centrifugal forward curved evaporator fans with two speed permanent split capacitor motor, permanent washable filters, positive pressure ventilation damper with concealed manual operator.
3. Heating Coil: Electric.
4. Condensate Drain: Drain pan to direct condensate to condenser coil for re-evaporation.
5. Condenser Fan: Centrifugal, forward curved, Propeller type with separate permanent split capacitor motor.

2.3 CONTROLS

A. Control Module: Unit mounted adjustable thermostat with heat anticipator, off-heat-auto-cool switch, high-low fan switch.

B. Low Ambient Lockout Control: Below 35 degrees F, outdoor thermostat shall switch to reverse cycle heating on cooling mode and on heat mode.

2.4 WALL SLEEVES AND LOUVERS

A. Wall Sleeves: See Architectural Drawings for required depth. 16-gauge galvanized steel with protective mastic coating.

B. Louvers: Flush Companion flanged anodized aluminum.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers' instructions.

B. Coordinate installation of units with architectural, mechanical, and electrical work.

C. Supply units fully charged with refrigerant and filled with oil.

D. Scheduled performance is based on AHRI 210/240 test conditions. Scheduled sound rating is based on ANSI/AHRI 300.

3.2 FIELD QUALITY CONTROL

A. Test and adjust through-the-wall heat pump units to ensure proper operation.
   1. Complete and thorough start-up of the refrigeration cycle.
   2. Check that setscrews are tightened and seated.

B. Provide operational test to demonstrate proper operation and adequate capacity at completion of balancing and adjusting.

C. Refer to and coordinate operational test with Sections 23 05 00 and 23 05 93.

3.3 DEMONSTRATION

A. Instruct OWNER personnel under provisions of Division 1 and Section 23 05 00.

B. Demonstrate system and instruct OWNER personnel in operation, repair, and maintenance of the work of this section

END OF SECTION 23 81 49

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SECTION 26 00 50 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic Electrical Requirements, materials and methods common to multiple electrical systems, specifically applicable to all Sections in Division 26.

1.2 REFERENCES

A. CEC - California Electrical Code, Part 3, CCR Title 24 and 2016 California Fire Code, Part 9, CCR Title 24.

B. NEMA ICS-6 - Industrial Control and Systems: Enclosures.

1.3 DEFINITIONS

A. The meaning of words must be as defined in the CEC Article 100, Definitions, unless defined otherwise in an individual section.

B. The following specification development organizations are referenced throughout the various specification sections of Division 26:
   1. AASHTO - American Association of State Highway and Transportation Officials.
   2. ADAAG - Americans with Disabilities Act Accessibility Guidelines
   3. Air Pollution Control District, Air Quality Management District
   4. ANSI - American National Standards Institute
   5. AQMD - Air Quality Management District
   6. APCD - Air Pollution Control District
   7. ASME - American Society of Mechanical Engineers
   8. ASTM - American Society for Testing and Materials
   9. CBC - California Building Code
   10. CCR - California Code of Regulations Title 24. State Chapters.
   11. CEC - California Electrical Code
   12. CFC - California Fire Code
   13. CMC - California Mechanical Code
   14. CSA - Canadian Standards Association
   15. EIA - Electronic Industries Association
   16. FCC - Federal Communications Commission.
   17. FM - Factory Mutual.
   18. FS - Federal Specifications
   19. ICEA - Insulated Cable Engineers Association
   20. IEC - International Electrotechnical Commission
   21. IEEE - Institute of Electrical and Electronic Engineers
   22. IETA - International Electrical Testing Association
   23. ISA - Instrument Society of America
   24. ISO - International Organization for Standardization
   25. MIL - Military Specifications
   26. NACE - National Association of Corrosion Engineers

27. NECA - National Electrical Contractor's Association
28. NEMA - National Electrical Manufacturing Association
29. NETA - International Electrical Testing Association
30. NFPA - National Fire Protection Association
31. NIST - National Institute of Standards and Technology
32. OSHA - Occupational Safety and Health Administration
33. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.
34. UL - Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. Performance Requirements
   1. Furnish and install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications required by reviewed shop drawings and field coordinated drawings.

1.5 SUBMITTALS

A. Product Data
   1. Submit product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
   2. Quantity of Submittals Required
      a. Submit three copies of product data.
      b. Two copies will be returned.
      c. If comments are required, comment sheet(s) will be returned with each copy.
      d. One copy will be retained by the Engineer.

B. Shop Drawings
   1. Submit shop drawings grouped to include complete submittals of related systems, products, and accessories in a single submittal.
   2. Quantity of Submittals Required:
      a. Submit one reproducible transparency and one print.
      b. Upon review, transparency will be annotated and returned. Print will be retained by Engineer.
      c. Copies of this transparency will serve as record copies for Architect and Engineer.
      d. Additional prints will not be reviewed nor returned.
   3. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:
      a. Confirming and correlating all quantities and dimensions.
      b. Selecting fabrication processes and techniques of construction.
      c. Coordinating his work with all other trades.
      d. Performing his work in a safe and satisfactory manner.
      e. Provide equipment that can be installed in the available space with all code clearances. This must be coordinated prior to ordering any equipment.

C. Samples
   1. Submit as directed by the architect and as required in each specification section.

D. Quality Control/Control Submittals

1. Submit material control record procedures for approval. Submit records during the project upon request by the County Representative. Submit at the end of the project for record.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Conform to CEC.
   2. Furnish products listed and classified by UL or other independent laboratory acceptable to County Representative as suitable for purpose specified and shown when a listing is available for the type of product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Maintain material control records for all products for traceability to manufacturer and order number. Have records available for inspection by County Representative.

B. Store material and equipment in an environment similar to the final installation environment.

C. Store and handle material and equipment in accordance with manufacturers' recommendations.

1.8 PROJECT CONDITIONS

A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare and submit drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of County Representative before proceeding.

1.9 STUDIES

A. Provide an arc flash study for review and approval for all new and existing electrical equipment re-used for the new work.

PART 2 - PRODUCTS

2.1 CONCRETE PADS AND PULL BOXES

A. At the Contractor's option, he shall provide cast-in-place or pre-cast structures.

B. Concrete Forms and Reinforcement Materials shall be as specified in Division 3 Section "Cast-in-Place Concrete".

C. Concrete shall be 2500-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place concrete".

D. Weatherproof concrete pull boxes, junction boxes and telephone boxes shall be manufactured by Christy Concrete Products or equal. All boxes shall have lids marked "Power", "Signal", "Fiber

Optic", "Danger-High Voltage", etc. and be traffic-rated per CalTrans drawing ES-8 minimum where pull box occurs in vehicular traffic areas.

2.2 RACEWAYS AND FITTINGS

A. Galvanized rigid steel conduit (GRC) shall meet ANSI C80.1, and be heavy wall, hot dipped galvanized inside and out, with threaded ends, for use with threaded type fittings.

B. Galvanized intermediate metallic conduit (IMC) shall meet ANSI C80.6, be zinc-coated steel and have threaded fittings.

C. Galvanized electrical metallic tubing (EMT) shall meet ANSI C80.3, and be continuous, seamless steel tubing, galvanized or sherardized on exterior, coated on interior with smooth hard finish of lacquer, varnish or enamel, with steel compression or die-cast compression type fittings. Provide concrete type fittings where required or water-tight compression fittings for wet locations.

D. Rigid non-metallic conduit (RNC) shall meet NEMA TC 2, be Schedule 40 PVC, suitable for 90 deg C, with solvent cemented type NEMA TC3 fittings.

E. Flexible metallic conduit (FMC) shall be single strip, continuous, flexible interlocked double-wrapped steel, hot dip galvanized inside and out forming smooth internal wiring channel, with steel, compression type fittings.

F. Liquid-tight flexible metallic conduit (LFMC) shall be same as FMC except with inert sunlight-resistant, mineral-oil-resistant watertight plastic outer jacket. Fittings shall be cast malleable iron body and gland nut, cadmium plated with one-piece brass grounding bushings threaded to interior of conduit. Spiral molded vinyl-sealing ring between gland nut and bushing and nylon-insulated throat.

G. All raceway fittings shall be specifically designed for the raceway type with which used.

2.3 CONDUCTORS

A. All conductors shall be delivered to the site in their original unbroken packages, plainly marked or tagged with UL labels, size, type of wire, type of insulation, name of the manufacturing company and trade name of the wire.

2.4 PULL BOXES AND WIREWAYS

A. Pullboxes and Enclosures for outdoor use shall be NEMA 250, Type 3R or Type 4, unless otherwise noted.

B. Pullboxes and Enclosures for indoor use shall be NEMA 250, Type 1, unless otherwise noted.

C. Wireways shall be constructed in accordance with UL 870 for wireways, auxiliary gutters and associated fittings. Every component including lengths, connectors and fittings shall be UL Listed.

D. Wireways and auxiliary gutters shall have continuous removable cover secured with screws and keyhole slots. Hinged cover shall be provided where installed above suspended ceiling.

E. Fabricated sheet steel pull boxes shall be installed only in dry, protected locations and shall be furnished with knockouts and removable screw cover. Box shall be finished with one coat of zinc

chromate and a coat of primer sealer and where exposed to public view shall be painted to match the surrounding surface.

F. Weatherproof sheet steel pull boxes shall be fabricated of code gauge galvanized sheet steel with two coats of rust resistant finish and shall be furnished with gasket and made completely weathertight.

2.5 WIRING DEVICES AND MATERIALS

A. Outlet Boxes shall meet NEMA OS1 and be galvanized code gauge steel. Boxes in masonry shall be square cornered. Boxes exposed to weather or in wet locations shall be Type FD cast metal with external threaded hubs and gasketed cover and shall meet NEMA FB1.

B. Outlet box extensions shall be U.L. listed and shall be attached to box with threaded metal screws. “Flash Guards” are not permitted to be used as box extensions.

C. Approved manufacturers of metal boxes are Circle AW, Crouse-Hinds, Steel City or equal.

D. Receptacles for Owner-furnished equipment shall match that equipment’s plug configuration. Device plates are required for all wiring devices, switches, outlets, and similar applications, and shall be as directed by architect. Pull boxes and junction to which no fixture is to be attached shall be fitted with blank cover plates painted to match surrounding.

2.6 TERMINAL CABINETS AND CLOSETS

A. Cabinets and fronts shall be in accordance with NEMA Standard Publication No. PB1- 1971 and UL Standards No. 67. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring loaded door pulls. The flush lock shall not protrude beyond the front of the door. All locks shall be keyed like the panel board locks. Fronts shall have adjustable indicating trim clamps that shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. Fronts shall not be removable with the door in the locked position. A frame and card with a clear plastic covering shall be provided on the inside of the door. Fronts shall be of code gauge full finished steel with rust inhibiting primer and baked enamel finish.

2.7 DISCONNECTING DEVICES

A. Disconnecting devices shall be provided as shown and/or as required by NEC.

B. Motor-rated switches shall be toggle-type, quick make-quick break, rated 2 HP, 250 VAC, with number of poles as required. They shall be equipped with overload heaters rated for overload protection of loads controlled.

C. Motor-rated switches shall be flush-mounted adjacent to load controlled. Where flush mounting is not possible, switches shall be surface mounted in NEMA enclosure suitable for environment in which installed.

D. Disconnect switches shall be 250V or 600V class, rated heavy-duty, horsepower rated, quick-make, quick-break, dead-front type and provided with proper number of poles.

E. Disconnect Switches shall be self contained in a NEMA 1 gasketed enclosure (NEMA 3R where installed outdoors) and externally operable from the front.

F. Fusible disconnect switches shall be equipped with rejection type clips suitable for UL Class R fuses up to 600A and suitable for UL Class L fuses above 600A. Fuse interrupting rating shall be 200,000 RMS symmetrical amperes.

G. Circuit breakers utilized as disconnecting devices shall comply with the requirements stated in other articles of this section and NEC.

2.8 FUSES

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Bussman
   2. Gould Shawmut
   3. Littlefuse

B. Fuses 600 amperes and below shall be UL Class RK1, 200,000 RMS symmetrical amperes interrupting rating.

C. Fuses 601 amperes through 4000 amperes shall be current limiting, 200,000 RMS symmetrical amperes interrupting rating.

2.9 SUPPORTING DEVICES

A. Supporting devices shall be constructed of cold-formed steel, with a corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal items for use outdoors or in damp locations shall be hot-dipped galvanized steel.

C. Slotted-steel channel supports shall have flanged edges turned toward the web, and 9/16-inch diameter slotted holes at a maximum of 2 inches on center, in the web.
   1. Channel thickness shall be selected to suit structural loading.
   2. Fittings and accessories shall be products of the same manufacturer as the channel supports.

D. Raceway and cable supports shall be manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe sleeves shall be ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, with plain ends.

F. Cable supports for vertical conduit shall be a factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs shall have number and size of conductor gripping holes as required to suit individual risers. Body shall be constructed of malleable-iron casting with hot-dip galvanized finish.

G. Concrete anchors shall be steel bolts with expansion anchors requiring a drilled hole. Powder driven anchors are not acceptable.

H. Toggle bolts shall be all-steel springhead type.

2.10 ELECTRICAL IDENTIFICATION

A. Identification devices shall be a single type of product for each application category. Colors shall be as prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and cable labels shall comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
   1. Pre-tensioned, wraparound plastic sleeves shall be a flexible, preprinted, color- coded, acrylic band sized to suit the diameter of the item it identifies.
   2. Preprinted, flexible, self-adhesive, vinyl labels shall have a legend, over- laminated with a clear, weather- and chemical-resistant coating.
   3. Color shall be black letters on orange background.
   4. Legend shall indicate voltage.

C. Self-adhesive colored marking tape for raceways, wires and cables shall be vinyl tape, not less than 1 inch wide by 3 mils thick.

D. Underground Warning Tape shall be vinyl tape, compounded for permanent direct-burial service, not less than 6 inches wide by 4 mils thick, embedded with a continuous metallic strip or core, brightly-colored, continuously-printed with a legend that indicates the type of underground line.

E. Tape markers for wire shall be vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Color-coding cable ties shall be made of Type 6/6 nylon, be self-locking type and of colors to suit coding scheme.

G. Engraved plastic labels, signs and instruction plates shall be made from black (or red as noted) Bakelite laminate engraving stock with a white core, punched or drilled for mechanical fasteners. It shall have a minimum thickness of 1/16-inch for signs up to 20 sq. in. and a minimum thickness of 1/8-inch for larger sizes.

H. Interior Warning and Caution signs shall comply with 29 CFR, Chapter XVII, Part 1910.145 and shall be preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

I. Exterior Warning and Caution signs shall comply with 29 CFR, Chapter XVII, Part 1910.145 and shall be weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. They shall be equipped with 1/4-inch grommets in each corner for mounting.

J. Fasteners for nameplates and signs shall be self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.11 TOUCHUP PAINT

A. Touch-up paint shall be equipment manufacturer’s paint selected to match installed equipment finish.

B. Touch-up paint on galvanized surfaces shall be zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL INSTALLATION

A. All material, equipment, devices, etc., shall be installed in accordance with the recommendations of the manufacturer of the particular item. The Contractor shall be responsible for all installations contrary to the manufacturer's recommendations. The Contractor shall make all necessary changes and revisions to achieve such compliance. Manufacturer's installation instructions shall be delivered to and maintained at the job site throughout the construction of the project.

B. The layout and installation of electrical work shall be coordinated with the overall construction schedule to prevent delay in completion of the project.

C. Dimensions and information regarding accurate locations of equipment and structural limitations and finish shall be verified with other sections.

D. The drawings do not show all raceway, wiring, offsets, bends, special fittings, junction or pull boxes necessary to meet job conditions. Items not shown as indicated, where are clearly necessary for proper operation or installation of systems shown, shall be provided as required, at no increase in contract price.

E. Materials and Components shall be installed level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

F. Electrical equipment, outlets, junctions and pull boxes shall be installed in accessible locations, avoiding obstructions, preserving maximum headroom, and keeping openings and passageways clear.

G. Equipment shall be installed to facilitate service, maintenance, and repair or replacement of components. It shall be connected for ease of disconnecting, with minimum interference with other installations. Minor adjustments in the locations of equipment shall be made where necessary providing such adjustments do not adversely affect function of the equipment. Major adjustments for the location of equipment shall be previously approved and detailed on the Record Drawings.

H. Right of Way shall be given to raceways and piping systems installed at a required slope.

3.2 RACEWAY APPLICATION

A. Galvanized Rigid Steel Conduit (GRC) may be used in all locations. Where installed in direct contact with earth, conduit shall be wrapped with two layers of half-lapped 10-mil PVC tape for a total thickness of 40-mil or have a factory applied 40-mil PVC coating.

B. Galvanized Rigid Steel Conduit (GRC) shall be used where exposed to physical damage, indoors where exposed to moisture, exposed outdoor installations, in systems higher than 600 volts, and where required by code.

C. Galvanized Electrical Metallic Tubing (EMT) may be used in dry indoor locations according to the following criteria:
   1. It is not subject to physical damage.
   2. It is not in direct contact with earth.
   3. It is not in concrete slabs.
   4. It is not in a hazardous area.

D. Galvanized Electrical Metallic Tubing (EMT) shall be used for general-purpose feeders and branch circuits.

E. Rigid Non-Metallic Conduit (RNC) may be used underground or below concrete slabs on grade.

F. Liquid-tight Flexible Metallic Conduit (LFMC) may be used in all locations to make final connections to motors, transformers, or other mechanical equipment (not to exceed 24 inches in length) or lighting fixtures (not to exceed 72 inches in length). Where specifically approved by the Engineer, LFMC may be used to facilitate wiring in tight locations or in other conditions that make the use of other conduit impracticable.

G. Flexible Metallic Conduit (FMC) may be used in dry locations to make final connections to motors, transformers, or other mechanical equipment (not to exceed 24 inches in length) or lighting fixtures (not to exceed 72 inches in length). Where specifically approved by the Engineer, FMC may be used to facilitate wiring in tight locations or in other conditions that make the use of other conduit impracticable.

3.3 RACEWAY INSTALLATION

A. General

1. Expansion joints shall be provided at building expansion joints or as required due to length of run or difference in temperatures.
2. All fittings that are exposed or in damp areas shall have sealing glands and proper gasket.
3. In general, all conduits shall be sloping to drain. Bends that place a trap in a conduit shall be avoided. Provided drip fitting as required. Dux-Seal high ends of all underground raceways.
4. All conduit runs shall be mechanically and electrically continuous from outlet to outlet. Conduit size or type shall not be changed between outlets.
5. All empty raceways shall be equipped with pull lines, capped and labeled. Pull lines shall be 3/16" polypropylene, No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 24 inches of slack with identification tag at each end of the pull wire.
6. Minimum size of any conduit for lighting, power and signal shall be ¾" conduit unless shown otherwise.
7. Use temporary raceway caps to prevent foreign matter from entering. Immediately prior to installation of conductors, conduit shall be blown and swept free of foreign materials. All conduit stubs for future, both above and below grade, shall be capped. Run conduits for spare panelboard circuits to attic or accessible spaces.
8. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
9. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
10. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
11. Conduits shall be securely fastened to building structure at intervals not greater than ten feet.
12. Conduit shall be square cut and reamed if required to full size, with thread full cut and true.
13. Conduits shall be jointed by approved couplings with ends of conduits tightly butted. Non-insulating compound shall be used in making up joints below grade or inside on grade to insure a watertight system.
14. Conduit connections to outlet boxes or cabinets shall be made with approved connectors, using locknuts and insulated throat bushings.

15. Complete raceway installation before starting conductor installation.
16. Contractor shall provide rubber grommets to fasten galvanized conduit to exterior structures made of dissimilar metals at all exterior locations to prevent galvanic corrosion.
17. Contractor shall provide rubber grommets to fasten galvanized conduit to supports which are also used by other systems utilizing piping of dissimilar metals to prevent galvanic corrosion.

B. Interior
1. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
2. All concealed conduits shall be installed in as direct a line as possible between outlets. No more than four quarter bends, or their equivalent, will be allowed between outlets. Feeder conduits shall follow arrangement shown on plans unless a change is authorized. Branch circuit conduits shall, in general, follow arrangement as shown as far as structural conditions permit. All exposed runs shall parallel buildings, walls, or partitions.

C. Flexible Conduit
1. LFMC or FMC shall be used to connect motors and equipment subject to vibration, noise transmission, or movement to junction boxes, with a maximum length of 24-inches.
2. Install separate ground conductor across flexible connections.
3. Flexible conduits shall be independently suspended.

3.4 CONDUCTOR INSTALLATION

A. Conductors shall be continuous from outlet to outlet, no splices shall be made except within outlet or junction boxes.

B. Wiring at outlets shall be installed with at least 6 inches of slack conductor at each outlet.

C. Outlet and component connections shall be made to wiring systems and to ground. Electrical connectors and terminals shall be tightened according to manufacturer's published torque-tightening values. Torque values specified in UL 486A shall be used where manufacturer's torque values are not indicated.

D. Wire in panels, cabinets, pull boxes, and wiring gutters shall be squared, labeled, and neatly grouped with cable ties and fanned out to the terminals.

E. All branch circuits, fixture wiring joints, splices, and taps for conductors #10 and smaller shall be made with 3M "Scotchlock" connectors, or approved equal.

F. All branch circuits, fixture wiring joints, splices, and taps for conductors #8 and larger shall be made with two-bolt type solderless connectors or T & B "color keyed" compression lugs.

G. Bolt-type solderless connectors shall be torqued with a torque wrench according to the manufacturer's recommendations, and then retightened after 24-48 hours before taping. Owners' inspector shall be informed of this procedure during the waiting period and shall witness the act of retightening.

H. Connectors and lugs for terminating stranded conductors #8 and larger shall be machine crimp compression type.

I. All splices shall be taped with Scotch #88 plastic electrical tape with "Scotch Fill" where necessary for a smooth joint. Scotch #27 or #2520 shall be used for other than normal temperatures or conditions.

All connections and splices shall be electrically perfect and in strict accordance with all code requirements.

J. No splices shall be made below grade in a manhole or pullboxes without Engineer's written approval, and then shall be encapsulated with 3M potting kits per 3M Specifications.

3.5 WIREWAY AND AUXILIARY GUTTER APPLICATION

A. Wireways and auxiliary gutters shall be used above and below panelboards, lighting relay cabinets, and terminal cabinets to accommodate large concentrations of wires as required.

3.6 PULL BOXES AND WIREWAYS:

A. Boxes shall be installed square and plumb. An engraved nameplate shall be installed on each box indicating its function. Nameplate shall be installed on the exterior of each box in unfinished areas and on the interior of each box in finished areas.

B. Wireways shall be installed with strip-type connectors with self-retained mounting screws. Hangers with two piece, hook together features shall be used to permit preassembly of wireway and hanger bottom plate before hanging on a preinstalled upper bracket.

C. Pull and junction boxes shall be installed as shown to ease the pulling of wire and to comply with CEC requirements.

3.7 WIRING DEVICES AND MATERIALS

A. Outlets shall be mounted at 18" minimum above finished floor unless otherwise noted.

B. The locations of outlets shown on drawings shall be located with respect to work of others and to be symmetrical with room layout.

C. Outlets in architectural patterned surfaces such as tile and finish panels shall be centered on intersections of four panels or in exact center of panels, unless otherwise shown on architectural plans or directed by Architect.

D. Outlet boxes for concealed work shall be one-piece steel knock out type with zinc coating. Boxes shall not be smaller than 4" square nominal size, unless otherwise indicated. Extension rings, plaster rings, and covers shall be provided as necessary for flush finish.

E. The Contractor shall inform himself of wall thickness throughout the building and shall provide outlet boxes of suitable depth that can be flush mounted and yet will be deep enough to contain the particular apparatus involved. Location of exposed pull or junction boxes will be subject to the Architect's approval.

F. Outlet boxes on opposite sides of walls shall not be placed back-to-back, nor shall "through" boxes be employed (except where specifically permitted on the drawings by note).

G. Switches shall be mounted 48" to center of device above finished floor unless otherwise noted.

H. Where more than one switch occurs at the same location, use multiple gang outlet boxes covered by a single plate; provide box partitions as required by the C.E.C.

I. Bar hangers shall be used to support outlet boxes in stud or furred partitions and ceilings. Attachment screws, devices, etc., shall be of the proper type to secure boxes to metal studs complemented by expansion shields to concrete and masonry.

J. All outlet boxes and particularly those supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. All lighting fixture outlets shall be coordinated with mechanical, architectural, or other equipment to eliminate conflicts and provide a workable, neat installation.

K. Approved knock out holes shall be provided. Outlet boxes from which light fixtures will be suspended shall be equipped with 3/8" fixture studs fastened through from back of box.

L. Surface boxes of the cast metal threaded hub type with suitable gasketed covers shall be used for exposed conduit runs less than 5' above a finished floor or where waterproof boxes are required.

M. Masonry boxes shall have conduit entrances to rear of box with depth as required to clear masonry.

N. Boxes shall be sized for number of conductors entering box.

O. Wiring devices shall be securely fastened to the outlet box. Where the outlet box covers are back from the finished walls, the device shall be built out with washers so that it is rigidly held in place to the box. Metal extenders shall be provided in flammable construction per CEC.

P. All device screw slots shall be left in a vertical orientation.

Q. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor and to outlet box with bonding jumper.

3.8 TERMINAL CABINETS AND CLOSETS

A. Terminal cabinets shall be installed level and identified with nameplate per schedule.

B. All conductors in terminal cabinets or closets shall be squared, labeled and secured neatly with wire ties.

C. All terminal cabinets shall be installed with the top of the trim at 6'-0" above the finished floor, unless otherwise indicated on the drawings.

D. Where space permits, terminal cabinets shall be surface mounted where they are not visible to the public.

E. A typewritten directory shall be mounted behind plastic in a metal holder welded to the inside of each terminal cabinet door showing a complete description of terminations in each cabinet.

3.9 DISCONNECT DEVICES

A. Thoroughly examine site conditions for acceptance of disconnects switch installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Coordinate locations of switches and equipment in the field to provide code required clearances in front of switches and to insure that switches are in sight of the controllers as described in CEC Article 430.

C. Install disconnect switches where indicated on the Drawings.

D. Install fuses in fusible disconnect switches.

E. Include construction channel and mounting hardware as required to support disconnect switch.

F. Provide engraved, machine screw retained nameplate on each disconnect switch.

3.10 SUPPORTING DEVICE APPLICATION

A. Hot-dip galvanized materials or nonmetallic channel and angle system components shall be used in damp locations and outdoors.

B. Steel materials shall be used in dry locations.

C. Support clamps for PVC raceways shall be click-type clamp system.

D. Strength of supports shall be adequate to carry present and future loads, times a safety factor of at least four with a minimum of 200-lb design load.

3.11 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, variable frequency drives, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, according to the following criteria, unless otherwise noted:
   1. Wood – wood screws or screw-type nails.
   2. Masonry – toggle bolts on hollow masonry units, expansion bolts on solid masonry units.
   3. New Concrete – concrete inserts with machine screws and bolts.
   4. Existing Concrete – expansion bolts.
   5. Steel – welded threaded studs or spring-tension clamps on steel. Field welding shall comply with AWS D1.1. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   6. Light Steel – sheet-metal screws.
   7. Fasteners shall be selected so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.12 ELECTRICAL IDENTIFICATION

A. Each conductor of every system shall be permanently tagged in each panelboard, pull box, J-box, etc., in compliance with the Occupational Safety and Health Administration (OSHA).

B. Brady labels shall be used to identify terminals and destination of feeders, branch circuits, signal and control circuits, etc., at all terminations, junction boxes and pull boxes, and shall be coordinated with the nameplates in all boxes and equipment.

C. All terminals in the switchboards, panels, relays, switches, devices, starter terminals, etc., shall have Brady labels for identification to identify both ends of all wiring.

D. The Contractor shall furnish and install 1” x 3” x 3/32” thick laminated black Bakelite nameplates with a white core (unless specifically shown as red) engraved to produce white letters on black background for all items of electrical equipment, including 2-pole and 3-pole circuit breakers, panelboards, starters, relays, time switches and disconnect switches. They shall screw them in place. Adhesively applied nameplates shall not be used.

E. All devices shall have their branch circuit identified on the back side of device plate with a permanent type black marker, i.e. CT A-21. Identify panelboard and circuit number from which receptacles are served. Use machine-printed, pressure-sensitive, abrasion- resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

F. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

G. Panels having single-pole circuit breakers shall be provided with typed schedules mounted in welded metal holders behind plastic.

H. Clean surfaces that are to receive self-adhesive identification products before applying.

I. Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.

J. Identify raceways and cables with color banding as follows:
   1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   3. Colors: As follows:
      a. Fire Alarm System: Red.
      b. Security System: Blue and yellow.
      c. Telecommunication System: Green and yellow.

K. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

L. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

M. All power conductors shall be identified in accordance with the following schedule:
   1. 120/208V, 3 Phase, 4 Wire System.
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White.
      e. Ground: Green
   2. 277/480V, 3 Phase, 4 Wire System.
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: White with a colored stripe or gray.
      e. Ground: Green.
   3. Isolated ground conductor shall be green with a yellow stripe.

N. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

3.13 FIRESTOPPING

A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration, either before, during, or after the fire. The fire and temperature ratings of the penetration assembly shall be at least that of the floor, wall, or

ceiling into which it is installed so that the original fire rating of the floor or wall is maintained as required by Article 300.21 of the California Electrical Code (CEC).

B. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs and similar structures. Where applicable, provide 3M fire barrier sealing penetration system, and/or Thomas and Bett Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps and other accessories as required. All manufacturers' instructions and recommendations for installation of sealing fittings and barrier sealing systems.

C. The Contractor shall repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed new structures, surfaces and shall install new fireproofing where existing firestopping has been disturbed. The repair and refinishing of materials and other surfaces shall be by skilled mechanics of the trades involved.

3.14 REFINISHING AND TOUCHUP PAINTING

A. The Contractor shall clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location. He shall follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

B. Damage to galvanized finishes shall be repaired with zinc-rich paint recommended by manufacturer.

C. Damage to PVC or paint finishes shall be repaired with matching touchup coating recommended by manufacturer.

3.15 SYSTEM TESTING AND STARTUP

A. Refer to Specification Section 26 95 00 ELECTRICAL ACCEPTANCE TESTS for minimum required systems testing and startup.

END OF SECTION 26 00 50

SECTION 26 01 00 – GENERAL CONDITIONS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 GENERAL CONDITION

A. The general provisions of the Contract, including General Conditions and Specification Division
   1. General Requirements, shall form a part of this Section, with the same force and effect as though repeated here. The provisions of this Section shall apply to all of the following Sections of Divisions of these Specifications and shall be considered a part of these Sections.

1.2 QUALITY ASSURANCE

A. All work and materials shall fully comply with current rules and regulations of all applicable codes. Nothing in these Drawings or Specifications shall be interpreted as to permit any work not in compliance with these codes. Where work is detailed and/or specified to a more restrictive standard or higher requirement, that standard or requirement shall govern such work. Applicable codes include, but are not limited to, the following:
   1. California Code of Regulations (CCR)
      a. Title 8, Industrial Relations
      b. Title 17, Public Health
      c. Title 24, Building Standards
   2. 2016 California Building Code.
   3. 2016 California Fire Code.
   4. 2016 California Electrical Code.
   5. Local Codes.

B. All electrical components, devices and accessories shall be listed with Underwriters Laboratories, Inc. (or other testing agency acceptable to authorities having jurisdiction), shall meet their requirements, shall bear their label wherever standards have been established and label service is regularly furnished by that agency, and shall be marked for intended use.

1.3 PERMITS, FEES AND TAXES

A. The Contractor shall secure all necessary permits and pay all required fees and taxes. He shall notify the proper authorities and have the work inspected and tested as required by jurisdictional requirements, pay all charges in connection therewith, and shall present to the Owner properly signed certificates of inspection. Acceptance of the work will not be considered until such certificates have been delivered.

1.4 TEMPORARY UTILITIES

A. The Contractor shall fulfill utility requirements for and pay all one-time and monthly charges for temporary construction utility usage.

1.5 EXISTING CONDITIONS

A. Construct The Contractor shall carefully examine the site and existing buildings, compare them with Drawings and Specifications, and shall have satisfied himself as to the conditions to be encountered during the performance of the work. No subsequent allowance shall be made on his

behalf for any additional expense he may incur due to failure or neglect of Contractor to examine site and to include existing conditions in bid.

B. Any work done as an addition, expansion, or remodel of an existing system shall be compatible with that system.

C. The Contractor shall examine all record drawings made available by the Owner to locate existing underground systems, utilities, conduits, and pipes prior to installing the electrical distribution system. The Contractor shall also examine the site for possible locations of sprinkler pipes. Any damage done to the existing systems during the course of the electrical work, whose locations could be reasonably determined, shall be repaired to the satisfaction of the Owner and the utility or agency involved, at the expense of the Contractor.

1.6 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. The Engineer's decision will be final on interpretation of the Drawings and Specifications. Whenever the words "AS MAY BE DIRECTED", "SUITABLE", or "APPROVED EQUAL", or other words of similar intent and meaning are used, implying that judgment is to be exercised, it is understood that it is in reference to the judgement of the Engineer.

1.7 COORDINATION

A. Electrical Drawings are essentially diagrammatic, unless specifically dimensioned. Some work may be shown offset for clarity. The actual locations of all materials, conduits, fixtures, supports, etc. shall be carefully planned prior to installation of any work in order to avoid all interferences with each other, or with architectural, civil, mechanical, plumbing, structural or other elements.

B. While the size and location of equipment are shown to scale wherever possible, all dimensions and conduit/conductor data shall be verified in the field.

C. Where the work requires connections to be made to equipment furnished and set in place by others, the Contractor shall obtain exact rough-in dimensions from the manufacturer of such equipment and he shall install the connections in a neat and workmanlike manner.

D. If discrepancies are discovered between Drawings and Specifications requirements, the more stringent requirement shall apply.

E. All conflicts shall be called to the attention of the Architect and the Engineer prior to the installation of any work or the ordering of any equipment.

F. No work shall be prefabricated or installed prior to this coordination. No additional compensation will be considered to the Contractor for any prefabrication or installation performed prior to this coordination.

1.8 SCHEDULING

A. All work shall be scheduled subject to the review of the Architect, Engineer and the Owner. No work shall interfere with the operation of the existing facilities on or adjacent to the site. The Contractor shall have at all times, as conditions permit, a sufficient force of workmen and quantity of materials to install the work for which contracted, as rapidly as possible consistent with good work, and shall cause no delay to other Contractors engaged upon this project or to the Owner.

1.9 WARRANTY

A. Guarantee shall be in accordance with the General Conditions. These Specifications may extend the period of the guarantee for certain items. Where such extension are called for, or where items are normally provided with guarantee periods in excess of that called for in the General Conditions, the Certificate of Guarantee shall be furnished to the Owner through the Engineer.

B. Contractor shall deliver to the Owner a written guarantee on all workmanship, materials and equipment for a period of one (1) year from the date of acceptance by the Owner. Any work found to be faulty during that period of time shall be corrected at once, upon written notification, at the expense of the Contractor. This shall include repair or replacement of the premises that may be damaged as a result of faulty work and materials furnished.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new unless otherwise noted.

B. Materials and equipment of a given type shall be by the same manufacturer.

C. Materials and equipment shall be covered or otherwise protected during construction as required to maintain the material and equipment in new factory condition until project acceptance. Upon completion of work and prior to final inspection, Contractor shall thoroughly clean all exposed fixtures, trim and equipment, and shall leave the entire installation in neat, clean, and useable condition. Materials and equipment shall be free of dents, scratches, marks, shipping tags, and all defacing features at time of project acceptance.

D. The Contractor shall order materials and equipment in a timely manner to prevent any delay in the construction schedule, and he shall bear any penalty by vendors to meet schedules.

E. Verify all dimensional information to ensure proper clearance for installation of equipment. Check all materials and equipment after arrival on the jobsite and verify compliance with the Contract Documents.

PART 3 EXECUTION

3.1 DEMOLITION

A. The Contractor shall protect existing electrical equipment and installations that are not indicated to be removed. If damaged or disturbed in the course of the Work, the Contractor shall immediately remove damaged portions and install new products of equivalent capacity, quality, and functionality.

B. Exposed electrical equipment and installations, indicated to be demolished, shall be removed in their entirety.

C. Demolished material shall be removed from Project site.

D. Components indicated for relocation shall be removed, stored, cleaned, reinstalled, reconnected, and made operational.

3.2 CUTTING AND PATCHING

A. The Contractor shall perform all cutting and drilling, or other work, required to provide openings in walls, ceilings, floors, paving, footings, foundations or other structures necessary to accomplish work under this Specification Division. The cutting shall be performed by skilled mechanics of the trades involved.

B. Cutting or coring shall not impair the strength of the structure. Any damage resulting from this work shall be repaired at the Contractor's expense to the satisfaction of the Architect.

C. Wherever possible, work shall be done in a concealed and neat workmanlike manner requiring the least amount of cutting of studs, plates and woodwork. Such cutting or notching is allowed only after consultation with and by permission of the Structural Engineer.

D. The Contractor shall repair and refinish disturbed finish materials and other surfaces to accurately match adjacent undisturbed new or existing structures and surfaces and shall install new fireproofing where existing fire-stopping has been disturbed. The repair and refinishing of materials and other surfaces shall be by skilled mechanics of the trades involved.

E. All cuts are to be clean with no chipping. Where chipping occurs as a result of work in a cut area, a new clean cut shall be made immediately prior to patching.

3.3 CLEANING AND PROTECTION

A. The Contractor shall, progressively and at completion of the job, thoroughly clean all of his work including outlets, fittings, and devices, and inspect exposed finishes. The Contractor shall remove all burrs, dirt, grease, paint spots, stains, labels, tags, rust, foreign material, and construction debris resulting from his work.

B. The Contractor shall protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 01 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Alpha Wire Company.
2. American Bare Conductor.
3. Southwire Company.

B. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in VFC circuits.

C. Conductors: Copper , complying with NEMA WC 70/ICEA S-95-658.

2.2 CONNECTORS AND SPLICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. 3M.
2. AFC Cable Systems, Inc.
3. Hubbell Power Systems, Inc.
4. ILSCO.

B. 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; stranded.

B. Branch Circuits: Copper; stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

B. Branch Circuits Concealed in Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

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."

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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 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."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections.
   1. Perform each of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each feeder 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.
      g. Continuity test on each conductor and cable.
      h. 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 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 26 05 19

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:
1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. ILSCO.

2.2 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: A qualified testing agency to perform tests and inspections.

B. 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.

C. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Requirements:
1. Section 260548 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Hangers.
   b. Steel slotted support systems.
   c. Nonmetallic support systems.
   d. Trapeze hangers.
   e. Clamps.
   f. Turnbuckles.
   g. Sockets.
   h. Eye nuts.
   i. Saddles.
   j. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Nonmetallic slotted-channel systems.
4. Equipment supports.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
   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. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
   2. Material: Galvanized steel.
   3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   4. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi Insert value, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements.

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 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 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 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal conduits, tubing, and fittings.
2. Surface raceways.
3. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND 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. Allied Tube & Conduit.
2. Southwire Company.
3. Thomas & Betts Corporation.
4. Western Tube and Conduit Corporation.
5. Wheatland Tube Company.

B. 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.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. 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, with overlapping sleeves protecting threaded joints.

G. 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 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated.
6. Thomas & Betts Corporation.
7. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

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: EMT .
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC.

C. Minimum Raceway Size: 3/4-inch 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 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. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings.

G. Install surface raceways only where indicated on Drawings.

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 away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. 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 of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. 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.

J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. 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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches 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.

R. 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. Install raceway sealing fittings according to NFPA 70.

S. 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.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches 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.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.

W. 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 box and cover plate or supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. Locate boxes so that cover or plate will not span different building finishes.

Z. 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.

AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 26 05 33

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SECTION 26 05 48 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Restraint channel bracings.
2. Seismic-restraint accessories.
3. Mechanical anchor bolts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

PART 2 - PRODUCTS

2.1 RESTRAINT CHANNEL BRACINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Unistrut; Atkore International.

B. 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, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.2 SEISMIC-RESTRAINT ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper B-Line, Inc.; a Division of Cooper Industries.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

2.3 MECHANICAL ANCHOR BOLTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Mason Industries, Inc.

B. 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 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables 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 caused by 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.

3.3 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."

B. Equipment and Hanger Restraints:
1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. 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.

E. 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Seismic controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48.16

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Indoor occupancy and vacancy sensors.
   2. Switchbox-mounted occupancy sensors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Show installation details for the following:
      a. Occupancy sensors.
      b. Vacancy sensors.
   2. Interconnection diagrams showing field-installed wiring.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of lighting control software.
      b. Faulty operation of lighting control devices.
   2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCYAND VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper Industries, Inc.
   2. Hubbell Building Automation, Inc.
   3. Leviton Manufacturing Co., Inc.

4. Watt Stopper.

B. General Requirements for Sensors:
   1. Ceiling-mounted, solid-state indoor vacancy sensors.
   2. Dual technology.
   3. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   4. Operation:
      a. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   5. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
   7. Bypass Switch: Override the "on" function in case of sensor failure.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. , and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
   4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted48 inches above finished floor.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper Industries, Inc.
   2. Leviton Manufacturing Co., Inc.
   3. Lutron Electronics Co., Inc.
   4. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchboxusing hardwired connection.
   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. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 5 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. 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.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. 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.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch .

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. 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.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 40 deg F to plus 100 deg F.
   b. Altitude: Not exceeding 1000 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 1000 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by the City or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager no fewer than two weeks in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's Construction Manager's written permission.
3. Comply with NFPA 70E.

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. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and 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.

2. Height: 84 inches 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.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Same finish as panels and trim.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Insert optional features.

H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Terminations shall allow use of 75 deg C rated conductors without derating.

I. 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.
1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

J. 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.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

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."

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Sector; Eaton Corporation.
   2. General Electric Company; GE Energy Management - Electrical Distribution.
   3. Siemens Energy.
   4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Sector; Eaton Corporation.
   2. General Electric Company; GE Energy Management - Electrical Distribution.
   3. Siemens Energy.
   4. Square D; by Schneider Electric.

B. 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. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

2.5 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.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

E. Arc Flash Warning labels: For new panelboards and any pandelboards altered by the construction, provide Arc Flash warning labels per CEC. Contractor shall coordinate short circuit ratings with Utility Company and provide an Arc Flash rating submittal for review. Labels shall be provided based on approved submittal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
   2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches Insert height above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

K. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.

L. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

M. 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.

N. Install filler plates in unused spaces.

O. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

P. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 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 City'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.

3.4 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. 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. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   2. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

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SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Straight-blade convenience.
2. GFCI receptacles.
3. Toggle switches.
4. Wall switch sensor light switches with dual technology sensors.
5. Wall plates.

1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:
1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 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.

D. Devices for City-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   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. Hubbell Incorporated; # 5362.
      b. Leviton Manufacturing Co., Inc.; # 16362.
      c. Pass & Seymour/Legrand (Pass & Seymour); 5362 (duplex).

2.3 GFCI RECEPTACLES

A. General Description:
   1. 125 V, 20 A, straight blade, non-feed-through type.
   2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, 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:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper Wiring Devices, Inc.
      b. Hubbell Incorporated.
      c. Leviton Manufacturing Co., Inc.; 7590.
      d. Pass & Seymour/Legrand (Pass & Seymour); 2095.

2.4 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:
      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) Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.; .
         2) Hubbell Incorporated; Wiring Device-Kellems; HBL1221.
         3) Leviton Manufacturing Co., Inc.; 1221-2.
         4) Pass & Seymour/Legrand (Pass & Seymour); 1221-G.

2.5 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Material for Finished Spaces: 0.05-inch- thick, anodized aluminum .
   2. Material for Unfinished Spaces: Galvanized steel.
   3. Material for Damp Locations: 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.

2.6 FINISHES

A. Device Color:
   1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Emergency Power System: Red.
   3. SPD 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. Pigtailing 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.
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 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.

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.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. 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.

D. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 115 to 125 V.
2. Ground Impedance: Values of up to 2 ohms are acceptable.
3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. 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.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 27 26

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SECTION 26 28 16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Nonfusible switches.
2. Enclosures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 40 deg F and not exceeding 100 deg F.
2. Altitude: Not exceeding 1000 feet.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2.2 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Areas: NEMA 250, Type 4X, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A.
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Lighting Fixture Schedule."

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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

1.5 INFORMATIONAL SUBMITTALS

A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Sample warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

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 and the luminaire will be fully operational during and after the seismic event."

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. Bulb shape complying with ANSI C79.1.

C. Rated lamp life of 50,000 hours.

D. Internal driver.

2.3 SURFACE MOUNT

A. Manufacturers: Subject to compliance with requirements, provide products as indicated on lighting fixture schedule or approved equal.

B. Integral junction box with conduit fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 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 26 51 19

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SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Related Requirements:
1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.

D. Pathway Fittings: Compatible with pathways 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 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.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-footintervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inches f slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

P. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

Q. Install devices to seal pathway 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 pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. 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 surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or 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 27 05 28

SECTION 27 05 44 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for pathway and cable penetration of non-fire-rated construction walls.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
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. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
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. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Walls:
1. Interior Penetrations of Non-Fire-Rated Walls:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 27 05 44

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SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the horizontal data cabling system as shown on the Drawings or as required to support the systems defined in these Specifications. The Work under this Section consists of furnishing materials and equipment, performing labor and services necessary for the installation of the horizontal data cabling system required for the communications system.

B. Related Sections:
1. Division 26 and 27 Specification sections.

1.2 SUBMITTALS

A. Submittals must be packaged in groups and must be made in accordance with the General Provisions of these specifications.

B. Warranty: Special warranties specified in this Section. When making the submittal as required include:
1. Sample of the warranty certificate(s) from the manufacturer(s) of the cabling and connectivity devices with the product data submittal.
2. Warranty certificate(s) from the manufacturer(s) of the cabling and connectivity devices when the completed test plan is submitted.

1.3 REFERENCES

A. TIA/EIA 568-B - Commercial Building Telecommunications Cabling Standard Set.

1.4 SYSTEM DESCRIPTION

A. The horizontal data cabling system must be furnished and installed to support TIA/EIA-568-B Category 6 communications.

B. Each Site Intercommunications and Local Area Network outlet must include a single copper data cable terminated to one RJ-45 568B jack mounted on the outlet.

C. The copper data cable must be routed, and terminated as indicated on the drawings.

D. All connections and color coding must be in conformance with the standards of the TIA/EIA-568B Category 6 standards.

1.5 WARRANTY

A. Special warranty: Manufacturer’s standard or customized form in which manufacturer and Installer jointly agree to replace, at no charge, defective materials or workmanship of horizontal cabling and connectivity devices within the specified warranty period.
1. The horizontal cabling and connectivity devices must be installed by a factory certified installer.
2. Install the copper system to TIA/EIA 568-B Category 6 standards.

3. The warranty must be signed by officers from each company.
4. All warranties must be transferable to CDCR.
5. Warranty Periods:
   a. Installer: Two years from date of Project Completion.
   b. Manufacturer(s): 20 years from date of Project Completion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Jacks:
1. Each outlet must have one TIA/EIA 568-B Category 6 UTP RJ-45 568A jacks with 110 style quick connect terminals.
2. Jack must be modular type allowing the jack to be easily removed from the cover plate without disconnecting any wires.
3. All jacks must be provided with a dust cover to keep the contacts clean when not in use.
4. The jack for the Site Intercommunications System outlets must be color coded blue and must be labeled voice.
5. The jack for the Local Area Network outlets must be color coded orange and must be labeled data.

B. Coverplates:
1. The coverplates for the outlets must be made of the same material (stainless steel, nylon, etc.) as the coverplates for duplex power receptacles furnished and installed under Division 26.
2. The coverplates must be no larger than a single gang face plate.

C. Station cable: The station cable must meet TIA/EIA 568-B Category 6 UTP requirements. Cable must be four twisted pair 24 AWG, solid conductors, PE insulation and jacketed with PVC. The PVC jacket color for the Site Intercommunications System outlets must be color coded blue. The PVC jacket color for the Local Area Network outlets must be color coded orange.

D. Patch Panels: Each backboard must be equipped with patch panels in quantities as required to terminate all cables.
1. Patch panels must be a RJ-45 568B patch panels with 110 terminations on the back.
2. Patch panels must be designed to be mounted to a rack. 2U.
3. Patch panel must be made of 16-gauge cold rolled steel.
4. RJ-45 contacts must be gold plated.
5. Patch panel must be labeled. Panduit # CPP48WBL or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Structure:
1. Form data cables at the back board in accordance with Category 6 TIA/EIA 568-B standards.

B. Termination:

1. Data cables must be terminated.

C. The cable jacket on both ends and the patch panel connector must be labeled. Label must have the following format:
   1. Room # - Outlet Designation.
   2. The outlet designation must be used when multiple outlets are located in the same room.

D. Pin Out:
   1. Color coding must conform to the TIA/EIA 568-B standards. The RJ-45 jack pin out must conform to designation 568B as defined in the TIA/EIA 568-B standards.

E. Installation:
   1. Under no load conditions the bend radius must be 1 inch or greater. Do not allow the bend radius to exceed the cable manufacturer's recommendations.
   2. The cable pair twists must be maintained to within 0.5 inch from the point of termination or less if required by the TIA/EIA 568-B standards.

3.2 COMPLETION

A. General: Upon completion of the Work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat and orderly.

B. Testing: The completed system must be tested by the Contractor prior to the acceptance test.
   1. Test all data circuits between the back board and the jacks for wire map; insertion loss; length; NEXT loss, pair-to-pair, measured from local end; NEXT loss, pair-to-pair, measured from far end; NEXT loss, power sum, measured from local end; NEXT loss, power sum, measured from far end; ELFEXT, pair-to-pair; ELFEXT, power sum; return loss, measured from local end; return loss, measured from far end; propagation delay; and delay skew with a Category 6 cable tester to ensure integrity of the cable plant. Submit test data in this section.

END OF SECTION 27 15 00

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SECTION 28 31 00 - FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The fire alarm system shall comply with requirements of NFPA Standard 72 with CA amendments for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

B. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

C. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

D. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

1.2 GUARANTEE:

A. The fire alarm control panel, voice panels and any head-end equipment shall have a manufacturer's warranty of a minimum of 3 years.

1.3 POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

1.4 APPLICABLE STANDARDS AND SPECIFICATIONS:

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

B. National Fire Protection Association (NFPA) - USA:

No. 12	Extinguishing Systems (low and high)
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 72	National Fire Alarm Code
No. 70	National Electric Code
No. 90A	Air Conditioning Systems
No. 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 217	Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No.60950	Safety of Information Technology Equipment

D. Local and State Building Codes.

E. All requirements of the Authority Having Jurisdiction (AHJ).

1.5 APPROVALS:

A. The system shall have proper listing and / or approval from the following nationally recognized or regional agencies:

UL	Underwriters Laboratories, Inc
ULC	Underwriters Laboratories Canada
FM	Factory Mutual
CSFM	California State Fire Marshal

B. The system shall be certified for seismic applications in accordance with the International Building Code (IBC).

PART 2 - PRODUCTS

2.1 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

A. Main FACP or network node shall be a NOTIFIER Model NFS-320 or approved equal and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

2.2 SYSTEM CAPACITY AND GENERAL OPERATION

A. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.

B. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire and gas detection system.

C. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.

D. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.

E. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.

F. The FACP or each network node shall provide the following features:
1. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
2. Detector sensitivity test, meeting requirements of NFPA 72.
3. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
4. Up to nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors, 0.5 to 2.5 percent per foot for ionization detectors, 0.5 to 4.0 percent per foot for acclimate detectors and 1.0 to 4.0 percent per foot for multi-criteria (IntelliQuad and IntelliQuad PLUS) detectors . The system shall also support sensitive advanced detection laser detectors with an alarm level range of .02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
5. The ability to display or print system reports.
6. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.

G. PAS presignal, meeting NFPA 72 requirements.
   1. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
   2. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
   3. Control-by-time for non-fire operations, with holiday schedules.
   4. Day / night automatic adjustment of detector sensitivity.

H. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits (NAC 1,2,3 and 4) shall also support Two-Stage operation. Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

I. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.
   1. This utility shall provide the ability to create and print NFPA style Test and Inspection reports
   2. This utility shall provide the ability to create and print Device Maintenance information

J. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

K. Each FACP or FACP network node shall support one SLC. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric, multi-criteria, thermal, laser, fire/CO) and 159 intelligent modules (monitor, control, relay, releasing) for a loop capacity of 318 devices. SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

L. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

2.3 SERIAL INTERFACES

A. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.

B. EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.

C. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.

D. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

2.4 SPECIFIC SYSTEM OPERATIONS

A. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.

B. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

C. Point Disable: Any addressable device may be enabled or disabled through the system keypad.

D. Point Read: The system shall be able to display or print the following point status diagnostic functions:
1. Device status
2. Device type
3. Custom device label
4. View analog detector values
5. Device zone assignments

E. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

F. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

G. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable.

The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

H. Software Zones: The FACP shall support 142 independent programmable software zones.

I. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

J. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
   1. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
   2. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
   3. All devices tested in walk test shall be recorded in the history buffer.

2.5 COMMUNICATORS:

A. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

B. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.

C. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.

D. Communication shall include vital system status such as:
   1. Independent Zone (Alarm, trouble, non-alarm, supervisory)
   2. Independent Addressable Device Status
   3. AC (Mains) Power Loss
   4. Low Battery and Earth Fault
   5. System Off Normal
   6. 12 and 24 Hour Test Signal
   7. Abnormal Test Signal (per UL requirements)
   8. EIA-485 Communications Failure
   9. Phone Line Failure

E. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

F. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.

G. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.

H. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

2.6 GATEWAY & WEBSERVER OPTIONS

A. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

2.7 SYSTEM COMPONENTS & ADDRESSABLE DEVICES

A. General
1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
7. The detectors shall be ceiling mount and shall include a separate teist-lock base with tamper proof feature.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use

to identify the type of device (ION, PHOTO, THERMAL).

10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.
14. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status; NOTIFIER model # NBG-12LX They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key. The key used to reset the pull station must be the same as the key used to lock and unlock the FACP door(s).
15. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
16. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

B. Intelligent Multi Criteria Acclimating Detector: The intelligent multi-criteria Acclimate® Plus™ detector shall be an addressable device, NOTIFIER model # FAPT-851, that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

1. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
2. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

C. Intelligent Thermal Detectors: The intelligent thermal detectors shall be NOTIFIER FST- series addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

D. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of

conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. The addressable monitor module shall be NOTIFIER model # FMM-1 (Class A or B) or FMM-101 (Class B)

2. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.
4. For multiple dry contact monitoring a module shall be available that provides 10 Style B or 5 Style D input circuits; NOTIFIER model # XP10-M.

E. Two Wire Detector Monitor Module
1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device); NOTIFIER model # FZM-1.
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For multiple 2-wire smoke detector circuit monitoring a module shall be available that provides 6 Style B/Class A or 3 Style D/Class B input circuits; NOTIFIER model # XP6-MA.

F. Addressable Control Module
1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances; NOTIFIER model # FCM-1
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y;
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.
4. For multiple circuit control a module shall be available that provides 6 Style Y (Class B) or 3 Style Z (Class A) control circuits; NOTIFIER model # XP6-C.

G. Addressable Relay Module:
1. Addressable Relay Modules shall be available for HVAC control and other network building functions; NOTIFIER model # FRM-1.
2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.
4. For multiple relay control a module shall be available that provides 6 programmable Form-C relays; NOTIFIER model # XP6-R.

H. SpectrAlert Advance Speakers
1. The Speaker appliance shall be System Sensor SpectrAlert Advance or equal. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible.

I. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance or equal. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit™ Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.
5. All notification appliances shall be backward compatible.
6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 TEST:

A. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

B. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

C. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

D. Verify activation of all waterflow switches.

E. Open initiating device circuits and verify that the trouble signal actuates.

F. Open and short signaling line circuits and verify that the trouble signal actuates.

G. Open and short notification appliance circuits and verify that trouble signal actuates.

H. Ground all circuits and verify response of trouble signals.

I. Check presence and audibility of tone at all alarm notification devices.

J. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

K. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

L. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION 28 31 00

SECTION 31 23 33 - TRENCHING AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Trenching and Backfill.

1.2 REFERENCES

A. ASTM References:
1. ASTM C33 - Concrete Aggregate.
2. ASTM C94 - Ready-Mixed Concrete.
3. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D422 - Test Method for Particle-Size Analysis of Soils
5. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)
7. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. ASTM D6938 - Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Caltrans Testing Methods:
1. #205 - Determining Percentages of Crushed Particles
2. #217 - Sand Equivalent
3. #229 - Durability Index

C. Caltrans Standard Specifications, current edition.

D. Electric & Gas Service Requirements 2017-2018 (PGE)

1.3 DEFINITIONS

A. Pipe Base: The trench area between the bottom of the trench and the bottom of the pipe. Extend full width and length of trench.

B. Pipe Zone: Area of trench between the top of the pipe base and six inches above the pipe, unless otherwise indicated. Extend full width and length of trench.

C. Backfill Zone: Area above Pipe Zone to finish grade.

D. Relative Compaction: Field-measured dry weight expressed as a percent of maximum dry density of same soil determined in accordance with ASTM D1557.

E. Unclassified Excavation: Nature of materials to be encountered is not identified or described.

1.4 DESCRIPTION

A. Provide materials, services, and equipment required for trenching, backfilling, and compacting.

B. An authorized OWNER Representative will approve all trenching, backfilling, and compacting operations prior to commencement. Conduct work under the general observation and, where required, the detailed inspection of the OWNER Representative. Do not backfill until each specific location is approved.

1.5 SUBMITTALS

A. Submit, under provisions of Division 1, product data and certificates of compliance for all materials proposed to be used under this Section

B. Submit methods and procedures for trenching, including but not limited to excavation, backfilling, compaction, and moisture addition or drying of all materials.

C. Submit "Shoring and Bracing Drawings" prior to beginning any trench or structure excavation 5 feet deep or over, in accordance with Section 6705, California Labor Code. If such plan varies from the shoring system standards established in the construction Safety Orders of the State of California, such alternative system plans must be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the Contractor's expense.

D. Submit a construction drainage plan showing the collection and disposal of surface and subsurface water that may be encountered in the course of construction.

1.6 QUALITY ASSURANCE

A. OWNER will employ and pay for services of an independent testing laboratory to perform specified testing per CCR Title 24, and any other testing specifically indicated in the Contract Documents to verify compliance with the Contract Documents.

1.7 FIELD CONDITIONS

A. Utility Locator Service: Notify USA North, by calling 811 or visiting their website at www.usanorth.org, for area where Project is located before beginning earth-moving operations.

B. Contractor to pothole as necessary, to avoid existing utilities.

PART 2 - PRODUCTS

2.1 PIPE BASE AND PIPE ZONE

A. Use sand conforming to ASTM C33 for conduit of any material less than 3-inch diameter and PVC pipe of any size.

2.2 BACKFILL MATERIAL

A. Native material: Free from organic and inorganic debris (including roots greater than ¼-inch in diameter) and containing materials no larger than 3-inches maximum size.

1. On-site soils shall not be used for bedding or initial backfill of utilities. On-site soils may be used for other trench backfill, except in areas where non-expansive, engineered fill is required.

B. Open graded gravel and rock material (e.g. ½-inch or ¾-inch crushed rock) shall not be used as backfill.

2.3 STRUCTURAL FILL UNDER AND AROUND VAULTS, MANHOLES, AND STRUCTURES

A. 3/4 inch Class 2 Aggregate Base or equivalent of crushed rock aggregate base material meeting the requirements of Section 32 11 23, "Aggregate Base Course".

2.4 CONCRETE FOR TRENCH BACKFILL

A. Conform to ASTM C94, Alternate 3. Proportion to obtain a 28-day compressive strength of 2,500 pounds per square inch. Use a minimum of five sacks of cement per cubic yard of concrete.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that native excavated material to be reused as backfill meets specified requirements and is acceptable to OWNER's Representative.

B. Verify lines and grades of proposed trench/utilities.

3.2 REMOVAL OF WATER

A. At all times, provide and maintain means and devices to remove and dispose of water entering trench during preparations for and during pipe laying, and until backfill of the pipe is complete.

B. Per Solano Geotech Report dated 7/2/2013, sample borings were detected at 8.5 ft below grade within the area but no Geotech report was provided for this project. Contractor shall notify OWNER if water is encountered during drilling operations. If de-watering is required, dewatering operations shall be performed prior to concrete work with all costs borne by contractor.

C. Verify groundwater elevations in areas where its presence is likely to impact construction activities.

D. Determine means and methods and perform dewatering as needed to establish a stable trench and structure base.

E. Dewatering facilities must be installed and functioning prior to excavation below groundwater levels in order to avoid heave of the trench bottom and/or trench wall instability. Plan sufficient time between dewatering and excavation to allow for drawdown of groundwater surfaces to below the lowest adjacent trench depths.

F. Water disposal must comply with Federal, State, and local requirements including the approved erosion control requirements for the project.

3.3 TRENCH EXCAVATION

A. DO NOT EXCAVATE BEFORE IDENTIFYING UNDERGROUND UTILITIES.

State law requires applicants to contact Underground Service Alert (USA) by dialing 811 a minimum of 2 working days before excavation (weekends and holidays excluded) or as required by OWNER. Ensure that you call USA when planning underground work, before digging begins, to allow adequate time for USA to determine the location of underground gas and electric lines or equipment. The potential for an accident exists if applicants fail to request USA to identify underground utility facilities before excavation begins. Excavate depth and width as shown or as directed. Allow for cover and pipe base under pipe. Remove loose matter.

B. Comply with CAL-OSHA requirements regarding trench bracing and shoring.

C. If Contractor elects to slope top of trench in lieu of trench bracing, maintain the trench width at least 2 feet above top of pipe before sloping begins. Unless otherwise approved by the OWNER Representative, slope no greater than1:1.

D. Furnish and install all shoring, sheeting and bracing required to support adjacent earth banks and structures for the protection and safety of all personnel working in the trench. All shoring, sheeting and bracing must conform to the requirements of the State or local agencies having jurisdiction over such matters. Remove shoring, sheeting and bracing in a manner that will protect the workman and prevent caving of banks and damage to the pipe, excavation, backfill or adjacent property.

E. Construct trenches to the line and grades as shown on the Contract Documents. Allow for pipe thickness, bedding material and stabilization material.

F. Backfill any part of the trench excavated below grade with fill material approved by OWNER Representative.

G. Install all pipe with grades less than 1 percent to grade and alignment established by an electronic, self-leveling, collimated laser which must have good visibility and meet all Federal, State, and Engineer requirements as to safety, operation and field use. The laser must have an off-grade warning system which must operate until the instrument is corrected to grade. The laser equipment must have a minimum accuracy of + 0.001 percent of grade, + 0.01 percent of alignment, and a minimum visible range of 600 feet. Periodically check the accuracy of the laser setting. Make corrections in grade as directed by the OWNER representative at no additional expense to OWNER.

H. The Contractor may use batter boards with a string line with horizontal level and vertical grade rod for grades over one percent, or may use other methods approved by the OWNER representative.

I. Dead flat or reverse grades are not acceptable.

J. Where pipelines are to be installed in embankments, place and compact embankments a minimum of 2 feet above the top of the pipe before trench excavation.

K. Where it is necessary to cross or parallel drainage ditches and swales or channels, carefully place and compact the backfill on the bottom and banks to 95 percent relative compaction with impervious material so as to avoid settlement or erosion. Restore the shape of the banks and leave bottom in good condition.

L. Electrical conduit shall include warning tape 12" below FG. Refer to electrical drawings.

3.4 PIPE BASE

A. Provide pipe base for supporting pipe for full width of trench. Unless shown otherwise, provide a minimum pipe base thickness of four inches below the pipe and three inches below the pipe bell.

B. Hand-grade ahead of pipe laying. Provide a firm, unyielding base.

C. If trench is excavated below required depth for pipe base, fill the excess depth with stabilization or pipe base/zone material to proper subgrade. Place pipe material for full width of trench in layers not exceeding six inches deep and compact until material does not yield or move.

D. Authorized overexcavation and backfill for subgrade stabilization will be paid for by contract change order when the exposed subgrade is unstable and subgrade stabilization is required, as determined by the OWNER Representative. Stabilization required as a result of the Contractor's operations or inadequate dewatering must be performed by the Contractor at no additional cost to the OWNER.

3.5 PIPE ZONE

A. Do not proceed with placing pipe zone material until pipe base stability has been approved by the OWNER Representative. Perform pipe base stabilization including dewatering and drying of the subgrade, removal of yielding soils as directed by the OWNER Representative and replacement with additional pipe base material, gravel or crushed rock (3-inch minus).

B. Use pipe zone material within the pipe zone except where concrete encased. Place material simultaneously on both sides of pipe in a manner approved by the OWNER Representative. Lifts in excess of six inches are not allowed.

C. "Walk-in" each lift of backfill. Slice with a shovel or tamp with J-bars or similar devices so that all voids around pipe are filled.

D. Give particular attention to zone from bottom of pipe to pipe springline. Ensure firm support to prevent lateral movement or pipe deflection during final backfilling.

3.6 BACKFILL ZONE

A. Backfill and compact all trenches below building slabs-on-grade and to 5 feet laterally beyond any edge.

B. Place moisture-conditioned backfill material in lifts not exceeding six inches for hand operated mechanical compactors and not exceeding eight inches for heavy equipment compactors.

C. Compact backfill to at least 95 percent relative compaction.

D. Jetting of backfill is not an acceptable means of compaction.

E. Where utility trenches cross underneath buildings, a sand cement slurry "plug" shall be placed within the trench backfill to help prevent the normally granular bedding materials from acting as a conduit for water to enter beneath the building. The plug should be constructed using a sand cement slurry (minimum 28-day compressive strength of 500 psi) or relatively impermeable native soil for pipe bedding and backfill. We recommend that the plug extend for a distance of at least 2 feet in each direction from the point where the utility enters the building perimeter.

3.7 SETTLEMENT OF PAVED AND UNPAVED AREAS

A. Repair all damage caused by settlement deemed to have occurred if the following conditions exist:
   1. In paved areas, settlement is defined as a depression of 3/8-inch or more below the average of the sides of the uncut portion.
   2. Along shoulder areas and unpaved portions of the roadways, settlement is defined as a depression of 3/4-inch or more below the average of the sides of the uncut portion.
   3. Across all unpaved areas, or areas untraveled by automotive equipment, settlement is defined as a depression of 1-1/2-inches or more below the average of the sides of the uncut portion. In this regard, any settlement that causes drainage problems or concentration causing water to run along the depression will be subject to correction immediately during the entire guaranty period.

3.8 PAVING REMOVAL

A. Saw cut asphalt concrete or concrete on roads before excavation. Cutting with a spade or jackhammer or grader-mounted wheel will not be allowed. Cut armor coats on roads with a suitable tool before excavation. Breaking of asphalt, concrete or armor coats with excavation equipment will not be permitted.

B. Cut all edges of asphalt concrete or armor coats vertically, with a neat, square edge.

C. In all cases, saw cut existing asphalt paving, concrete, or armor coating after construction and just prior to final paving to a point 6 inches or wider than each side of the trench line. Make saw cuts parallel or perpendicular to center line of the trench.

D. Dispose of excess paving per the OWNER Representative's direction. Such excess paving may not be used as backfill material.

3.9 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Division 01.

B. OWNER Representative will conduct nuclear gauge moisture and density testing in accordance with ASTM D6938 procedures on each 100 feet of compacted lift of trench materials placed (minimum of 1 test per 100 feet) or as directed by the OWNER Representative.

END OF SECTION 31 23 33

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SECTION 32 11 23 - AGGREGATE BASE

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:
1. Summary
2. Applicable Publications
3. Submittals
4. Aggregate Base
5. Aggregate Base Compaction

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

C. Description:
1. Furnishing and spreading of aggregate base as shown on the pavement section on the plans.
2. Compact to 95% relative compaction to the total depth shown on the plans.
3. Re-grade to allow for the placement of new asphalt as shown on the plans to meet the existing finish grade of the areas surrounding the work and allow for drainage of the new pavement area. Fine grade to the grades required prior to placement of asphalt.
4. Other ancillary items of work as shown on the drawings and as specified on this Section

1.2 APPLICABLE PUBLICATIONS

The publications of the most recent edition and addenda listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

A. The State of California Department of Transportation Standard Specifications (CALTRANS)

B. American Society for Testing and Materials (ASTM)

ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54 kg) Rammer and 18-inch (457 mm) Drop
ASTM D2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

A. An aggregate mix design conforming to provisions in Section 26 “Aggregate Bases,” CALTRANS.

1. The results of quality testing for Sand Equivalent and R-value (if Sand Equivalent is less than 55). This requirement shall not be considered to be in lieu of material testing otherwise required by the Engineer.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE

Aggregate Base shall be Class 2 (3/4-inch maximum aggregate) conforming to provisions in Section 26, "Aggregate Bases," CALTRANS. Except that the reclaimed material can comprise 100% of the mix.

A. The aggregate shall not be treated with lime, cement, or other chemical material before performing Durability Index, Grading (Sieve Analysis), Resistance (R- Value) or sand equivalent.

B. The R-value may be waived provided the material has a Sand Equivalent of 55 or more.

C. The moving average percent passing will not be used.

PART 3 - EXECUTION

3.1 AGGREGATE BASE COMPACTION

A. Aggregate Base shall be compacted in accordance with Section 26-1.05 "COMPACTING" (Aggregate Bases)" CALTRANS.

B. Whenever this Section require compliance with specified values for the following properties, test will be made by the California Test or ASTM Test indicated unless otherwise specified:

Properties	California Test	ASTM Test
Relative Compaction	216 or 231	D 1557

C. Whenever a reference is made herein to a Test by number, it shall mean the California or ASTM Test in effect on the day the Notice to Proceed is issued.

END OF SECTION 32 11 23

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The scope of work in this section includes, but is not necessarily limited to concrete sidewalk, stamped concrete, commercial driveways, pedestrian ramps and related concrete improvements as shown on drawings and specified below.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 013300 - Submittal Procedures

1.3 REFERENCE STANDARDS

A. Standard Specifications
   1. State of California, Department of Transportation, Standard Specifications, July, 2010.

B. Standard Drawings
   1. State of California, Department of Transportation, Standard Plans, 2010.
   2. American Society for Testing and Materials, referred to hereinafter as ASTM.

1.4 SUBMITTALS

A. Materials List/Samples
   1. Within 7 days of contract award, provide complete list of proposed materials to the City's Representative. Submittals shall include but are not limited to mix design, air-entraining admixtures and related product data. Contractor shall supply test data for compressive strength, air-entrainment and slump per SSPWC Section 201.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Where criteria shown on drawings or specified in this specification exceed that of the referenced standards, and the work involves non-public improvements, the more stringent criteria shall apply.

B. The following shall be the minimum concrete strengths for concrete paving work:
   1. Concrete Sidewalk : 560-C-3250
   2. Driveways and curb and getter : 560-C-3250
   3. Stamped Median Concrete per SDG-112: 560-C-3250
   4. Pedestrian Ramps" 560-C-3250

2.2 PORTLAND CEMENT CONCRETE

A. Concrete shall consist of Portland cement, concrete aggregates, water, and when specified or approved for use, chemical admixtures, and/or SCMs, fibers, color, and/or reclaimed concrete material. Concrete shall be specified by class, alternate class, special exposure, or compressive strength, and shall be per Section 201-1 of the SSPWC.

B. Concrete shall be integral color per Section 303-7.3 Method B - Integral Color of the SSPWC.

2.3 EXPANSION JOINT MATERIAL

A. Expansion Joints: Conform to ASTM D-1751, size, height, and location as noted on the drawings. Joints shall be impregnated felt unless otherwise specified on drawings. Provide zip strip and sealant as indicated.

2.4 JOINT SEALANT MATERIAL

A. Joint sealant material shall be per Section 201-3 of the SSPWC. When adjacent to integral color concrete, color shall match integral color.

2.5 WEAKENED PLANE JOINTS

A. Greenstreak 852 or equal. No saw cutting or “zip-strip” joints permitted. Use of custom joint forming tool acceptable with prior City's Representative approval.

2.6 CURING COMPOUND

A. Provide Burke Aqua Resin or equal, with fugitive dye, and complying with ASTM C309, Type 1-D at all natural color concrete.

B. Provide colored concrete curing compound per Section 303-7.4 of the SSWPC and comply with ASTM C309.

2.7 TRUNCATED DOMES

A. The tiles shall have the manufacturer's logo stamped permanently on the product with identifying information such as model number and type. Color shall be safety yellow per Federal Yellow FS 33538 of Federal Standard 595 C. The surface of the panels shall be protected by plastic cover provided by the manufacturer. Manufacturer of the truncated domes shall be Armorcast, Access Tile, or approved equal.
   1. ARMORCAST Detectable Warning Panels, Wet Set 3' x 4' Panel with color matching bolts and five (5) year manufacturer warranty.
   2. ACCESS TILE, Tactile System, 3' x 4' cast in place replaceable and surface applied panels with color matching stainless steel bolts and five (5) year manufacturer warranty.

2.8 OTHER MATERIALS

A. All other materials, not specifically described but required for complete and proper installation of this work, shall be selected by the Contractor and subject to the approval of the City.

PART 3 - EXECUTION

3.1 SURFACE CONDITION

A. Inspection
1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that concrete pavement may be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

B. Discrepancies
1. In the event of discrepancy, immediately notify the City.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FORMWORK

A. General
1. Construct forms accurately to dimensions, plumb and true to line and grade.
2. Use forms that are substantial, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.
3. Wavy surfaces and bulged walls or slap surfaces resulting from settlement or springing of formwork will be rejected.
4. Carefully verify and check all forms for alignment/elevation and level as the work proceeds. Promptly make all needed adjustments or additional bracing.

B. Construction Joints
1. Construct and assemble forms in such a manner that joints occur at accepted locations. Thoroughly clean forms before pouring concrete.

C. Details
1. Take extreme care in all details of forming, setting and reinforcing. Except when tooled or radiuses corners are indicated, provide all exposed concrete finish work with smooth, even surfaces of dense concrete with clean sharp arises and outside corners.

D. Prior to Pouring Concrete
1. Thoroughly clean out all forms to be used.
2. Thoroughly wet wood forms as required where coatings form are not used. E.

E. Removal of Forms
1. Do not remove support forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.
2. Remove forms only after concrete has properly set and without damaging concrete.

3.3 CONCRETE PAVING INSTALLATION

A. Preparation

1. Verify sub-grade, conduit and all other embedded items are properly located in relation to concrete paving. Verify all grades for pitch and fall prior to pouring pavements.
2. Verify that all cross-fall and ramp criteria comply with Title 24 requirements.

B. Placement
1. Install all natural and color concrete paving per Section 303-5 and Section 303-7 of the SSPWC respectively, as specified and as shown on drawings.
2. Install all curbing, cross gutters, and related improvements per Section 303-5 of the SSPWC, as specified herein, and as shown on drawings. Where machine formed curbing is provided, tolerances and joint control specified for fixed form construction shall be met.

C. Finishing
1. Broom Finish shall be applied to sidewalks, dock areas and entrance door stoops.
2. Float and steel trowels to required slopes and planes. Apply broom texture, transverse to direction of pedestrian travel, and using a stiff wire or nylon bristle broom. Broom finish texture to be approved by City for various applications.

D. Joint Treatment
1. Provide construction, expansion, and weakened plane joints as required by RSD for sidewalks, curbs and concrete pavement areas.
2. Hold expansion joint filler material below paving surface minimum 1/2 inch with zip strip on top of joint filler material.
3. Properly prepare edges of joints prior to proceeding with subsequent operations. Remove all contaminants laitance, oil and other deleterious substances prior to installing joint sealant.
4. Install joint sealant at all expansion joints per manufacturer's recommendations. Provide bond breaker at expansion joint filler. Tool joint sealant concave. Remove excess from joint edges.

3.4 CONCRETE CURING

A. General
1. Concrete curing shall conform to Section 303-5.6 of the SSPWC for natural concrete and Section 303-7.4 of the SSPWC for colored concrete.

3.5 TRUNCATED DOMES

A. Cast-in-place installation: verify cast-in-place concrete surface condition with the Engineer prior to installation. Install truncated domes per manufacturer's installation instructions.

B. Surface applied installation: Grind and prepare the existing concrete surface and verify the surface condition with the Engineer prior to installation. Install truncated domes per manufacturer's installation instruction.

C. Contractor shall not remove plastic protective cover from the tile panels until its installation. Any damaged tile panels shall be replaced at Contractors own cost.

3.6 FIELD QUALITY CONTROL

A. Inspection and Testing
   1. Evaluate surfaces for grade and drainage. Correct all non-conforming surfaces, ponds and other irregularities to the satisfaction of the City.

3.7 ALLOWABLE TOLERANCES

A. General
   1. Variations below list the maximum permissible deviations form established lines, grades and dimensions for all exposed concrete paving.

B. Variation from Plumb
   1. In the lines and surfaces of pavements: In 10 feet, maximum 1/4 inch.
   2. For exposed corners, control-joint grooves and other conspicuous lines.
      a. In any 10 feet, maximum 1/4 inch
      b. In any 20 feet or more, 1/2 inch

C. Variation from the Level or from the Grades shown per Drawings:
   1. In pavements, tops of curbing, exposed joints and other conspicuous lines:
      a. In any 10 feet, 1/4 inch maximum.

D. Variation in Cross-Sectional Thickness of Slabs, without reducing tolerances established for line, plumb and level.
   1. Minus 1/4 inch, plus 1/2 inch.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

END OF SECTION 32 13 13

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